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BSM- 4101K
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SERVICE MANUAL

Life Scope P
BEDSIDE MONITOR

BSM-4100

0634-001539E

NIHON KOHDEN

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GENERAL HANDLING PRECAUTIONS

This device is intended for use only by qualified medical personnel.
Use only Nihon Kohden approved products with this device. Use of non-approved products or in a non-approved manner may affect the performance specifications of the device. This includes, but is not limited to, batteries, recording paper, pens, extension cables, electrode leads, input boxes and AC power.

Please read these precautions thoroughly before attempting to operate the instrument.

1. **To safely and effectively use the instrument, its operation must be fully understood.**

2. **When installing or storing the instrument, take the following precautions:**
   (1) Avoid moisture or contact with water, dust, extreme atmospheric pressure, excessive humidity and temperatures, poorly ventilated areas, and saline or sulphuric air.
   (2) Place the instrument on an even, level floor. Avoid vibration and mechanical shock, even during transport.
   (3) Avoid placing in an area where chemicals are stored or where there is danger of gas leakage.
   (4) The power line source to be applied to the instrument must correspond in frequency and voltage to product specifications, and have sufficient current capacity.
   (5) Choose a room where a proper grounding facility is available.

3. **Before Operation**
   (1) Check that the instrument is in perfect operating order.
   (2) Check that the instrument is grounded properly.
   (3) Check that all cords are connected properly.
   (4) Pay extra attention when the instrument is in combination with other instruments to avoid misdiagnosis or other problems.
   (5) All circuitry used for direct patient connection must be doubly checked.
   (6) Check that battery level is acceptable and battery condition is good when using battery-operated models.

4. **During Operation**
   (1) Both the instrument and the patient must receive continual, careful attention.
   (2) Turn power off or remove electrodes and/or transducers when necessary to assure the patient's safety.
   (3) Avoid direct contact between the instrument housing and the patient.

5. **To Shutdown After Use**
   (1) Turn power off with all controls returned to their original positions.
   (2) Remove the cords gently; do not use force to remove them.
   (3) Clean the instrument together with all accessories for their next use.

6. **The instrument must receive expert, professional attention for maintenance and repairs. When the instrument is not functioning properly, it should be clearly marked to avoid operation while it is out of order.**

7. **The instrument must not be altered or modified in any way.**

8. **Maintenance and Inspection:**
   (1) The instrument and parts must undergo regular maintenance inspection at least every 6 months.
   (2) If stored for extended periods without being used, make sure prior to operation that the instrument is in perfect operating condition.

(3) Technical information such as parts list, descriptions, calibration instructions or other information is available for qualified user technical personnel upon request from your Nihon Kohden distributor.

9. When the instrument is used with an electrosurgical instrument, pay careful attention to the application and/or location of electrodes and/or transducers to avoid possible burn to the patient.

10. When the instrument is used with a defibrillator, make sure that the instrument is protected against defibrillator discharge. If not, remove patient cables and/or transducers from the instrument to avoid possible damage.

WARRANTY POLICY

Nihon Kohden Corporation (NKC) shall warrant its products against all defects in materials and workmanship for one year from the date of delivery. However, consumable materials such as recording paper, ink, stylus and battery are excluded from the warranty.

NKC or its authorized agents will repair or replace any products which prove to be defective during the warranty period, provided these products are used as prescribed by the operating instructions given in the operator's and service manuals.

No other party is authorized to make any warranty or assume liability for NKC's products. NKC will not recognize any other warranty, either implied or in writing. In addition, service, technical modification or any other product change performed by someone other than NKC or its authorized agents without prior consent of NKC may be cause for voiding this warranty.

Defective products or parts must be returned to NKC or its authorized agents, along with an explanation of the failure. Shipping costs must be pre-paid.

This warranty does not apply to products that have been modified, disassembled, reinstalled or repaired without Nihon Kohden approval or which have been subjected to neglect or accident, damage due to accident, fire, lightning, vandalism, water or other casualty, improper installation or application, or on which the original identification marks have been removed.

In the USA and Canada other warranty policies may apply.

CAUTION

United States law restricts this device to sale by or on the order of a physician.

EMC RELATED CAUTION

This equipment and/or system complies with the International Standard IEC 60601-1-2 for electromagnetic compatibility for medical electrical equipment and/or system. However, an electromagnetic environment that exceeds the limits or levels stipulated in the IEC 60601-1-2, can cause harmful interference to the equipment and/or system or cause the equipment and/or system to fail to perform its intended function or degrade its intended performance. Therefore, during the operation of the equipment and/or system, if there is any undesired deviation from its intended operational performance, you must avoid, identify and resolve the adverse electromagnetic effect before continuing to use the equipment and/or system.

The following describes some common interference sources and remedial actions:

1. **Strong electromagnetic interference from a nearby emitter source such as an authorized radio station or cellular phone:**
   Install the equipment and/or system at another location if it is interfered with by an emitter source such as an authorized radio station. Keep the emitter source such as cellular phone away from the equipment and/or system.

2. **Radio-frequency interference from other equipment through the AC power supply of the equipment and/or system:**
   Identify the cause of this interference and if possible remove this interference source. If this is not possible, use a different power supply.

3. **Effect of direct or indirect electrostatic discharge:**
   Make sure all users and patients in contact with the equipment and/or system are free from direct or indirect electrostatic energy before using it. A humid room can help lessen this problem.

4. **Electromagnetic interference with any radio wave receiver such as radio or television:**
   If the equipment and/or system interferes with any radio wave receiver, locate the equipment and/or system as far as possible from the radio wave receiver.

If the above suggested remedial actions do not solve the problem, consult your Nihon Kohden Corporation subsidiary or distributor for additional suggestions.

The CE mark is a protected conformity mark of the European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.

The CE mark only applies to the BSM-4100K Bedside Monitors.

This equipment complies with International Standard IEC 60601-1-2 (1993) which requires CISPR11, Group 1, Class B. Class B EQUIPMENT is equipment suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

In IEC 60601-1-2 Medical Electronic Equipment, Part 1: General Requirements for Safety, 2. Collateral Standard: Electromagnetic compatibility-Requirements and test. Section 36. 202. 2 Radiated radio-frequency electromagnetic fields, PATIENT COUPLED EQUIPMENT and/or SYSTEMS applicable IMMUNITY test methods are under consideration at SC62A/WG13. The 3 V/m IMMUNITY level may be inappropriate especially when measuring SpO_2 because physiological signals can be much smaller than those induced by a 3 V/m electromagnetic field.

When measuring SpO_2, various interference may produce false waveforms which look like pulse waveforms. SpO_2 value and pulse rate may be measured from these false waveforms, causing the alarm to function improperly.

When installing the monitor, avoid locations where the monitor may receive strong electromagnetic interference such as radio or TV stations, cellular phone or mobile two-way radios.

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment*

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. If this occurs, disconnect the monitor or diagnostic equipment from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden distributor.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the patient, resulting in an elevated pacing rate.

  For more information, see the FDA web site.
  http://www.fda.gov/cdrh/safety.html

NOTE about Waste Electrical and Electronic Equipment (WEEE) directive 2002/96/EEC
For the member states of the European Union only:
The purpose of WEEE directive 2002/96/EEC is, as a first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste.
Contact your Nihon Kohden representative for disposal at the end of its working life.

Conventions Used in this Manual and Instrument

Warnings, Cautions and Notes

Warnings, cautions and notes are used in this manual to alert or signal the reader to specific information.

WARNING

A warning alerts the user to possible injury or death associated with the use or misuse of the instrument.

CAUTION

A caution alerts the user to possible injury or problems with the instrument associated with its use or misuse such as instrument malfunction, instrument failure, damage to the instrument, or damage to other property.

NOTE

A note provides specific information, in the form of recommendations, prerequirements, alternative methods or supplemental information.

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Introduction

This service manual provides useful information to qualified personnel to understand, troubleshoot, service, maintain and repair the BSM-4100A/J/K Bedside Monitor (referred to as “the instrument” in this service manual).

All replaceable parts or units of this instrument are clearly listed with exploded illustrations to help you locate the parts quickly.

The “Maintenance” section in this service manual describes the maintenance that should be performed by qualified service personnel. The “Maintenance” section in the operator’s manual describes the maintenance that can be performed by the user.

The information in the operator’s manual is primarily for the user. However, it is important for service personnel to thoroughly read the operator’s manual and service manual before starting to troubleshoot, service, maintain or repair this instrument. This is because service personnel need to understand the operation of the instrument in order to effectively use the information in the service manual.

General Information on Servicing

Note the following information when servicing the instrument.

CAUTION

Safety

- **There is the possibility that the outside surface of the instrument, such as the operation keys, could be contaminated by contagious germs, so disinfect and clean the instrument before servicing it. When servicing the instrument, wear rubber gloves to protect yourself from infection.**
- **There is the possibility that when the lithium battery is broken, a solvent or toxic substance inside the lithium battery could leak out. If the solvent or toxic substance touches your skin or gets into your eye or mouth, immediately wash it with a lot of water and see a physician.**

Liquid ingress

The instrument is not drip-proof, so do not install the instrument where water or liquid can get into or fall on the instrument. If liquid accidentally gets into the instrument or the instrument accidentally drops into liquid, disassemble the instrument, clean it with clean water and dry it completely. After reassembling, use the patient safety checks and function/performance checks to verify that there is nothing wrong. If there is something wrong with the instrument, contact your Nihon Kohden representative for repair.

Environmental Safeguards

Depending on the local laws in your community, it may be illegal to dispose of the lithium battery and CRT unit in the regular waste collection. Check with your local officials for proper disposal procedures.

Disinfection and cleaning

To disinfect the outside surface of the instrument, wipe it with a non-abrasive cloth moistened with any of the disinfectants listed below. Do not use any other disinfectants or ultraviolet rays to disinfect the instrument.

- **Chlorohexidine gluconate solution: 0.5%**
- **Benzethonium chloride solution: 0.2%**
- **Glutaraldehyde solution: 2.0%**
- **Benzalkonium chloride: 0.2%**
- **Hydrochloric alkyl diaminoethylglycine: 0.5%**

Transport

- **Use the specified shipment container and packing material to transport the instrument. If necessary, double pack the instrument. Also, put the instrument into the shipment container after packing so that the buffer material does not get inside the instrument.**
- **When transporting a board or unit of the instrument, be sure to use a conductive bag. Never use an aluminum bag when transporting the power board, power unit or board on which a lithium battery is mounted. Also, never wrap the board or unit of the instrument with styrene foam or a plastic bag which generates static electricity.**

Handling the instrument

- **Because the outside surface of the instrument is made of resin, it is easily damaged. When handling the instrument, remove clutter from around the instrument and be careful not to damage the instrument or get it dirty.**
- **Because most of the boards in the instrument are multilayer boards with surface mounted electrical devices (SMD), a special tool is required when removing and soldering the electrical devices. To avoid damaging other electrical components, do not remove and solder SMD components yourself.**

Measuring and Test Equipment

Maintain the accuracy of the measuring and test equipment by checking and calibrating it according to the check and calibration procedures.

Service Policy, Service Parts and Patient Safety Checks

Service Policy

Our technical service policy for this instrument is to replace the faulty unit, board or part or damaged mechanical part with a new one. Do not perform electrical device or component level repair of the multilayer board or unit. We do not support component level repair outside the factory for the following reasons:

- Most of the boards are multilayer boards with surface mounted electrical devices, so the mounting density of the board is too high.
- A special tool and special repair skill is required to repair the multilayer boards with surface mounted electrical devices.

Disassemble the instrument or replace a board or unit in an environment where the instrument is protected against static electricity.

As background knowledge for repair, pay special attention to the following:

- You can reduce the repair time by considering the problem before starting repair.
- You can clarify the source of most of the troubles using the information from the diagnostic check function of the instrument. Refer to "Diagnostic Check " of this manual.

Service Parts

Refer to "Replaceable Parts List" of this manual for the service parts for technical service that we provide.

NOTE

When ordering parts or accessories from your Nihon Kohden representative, please quote the NK code number and part name which is listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs. Always use parts and accessories recommended or supplied by Nihon Kohden Corporation to assure maximum performance from your instrument.

Patient Safety Checks

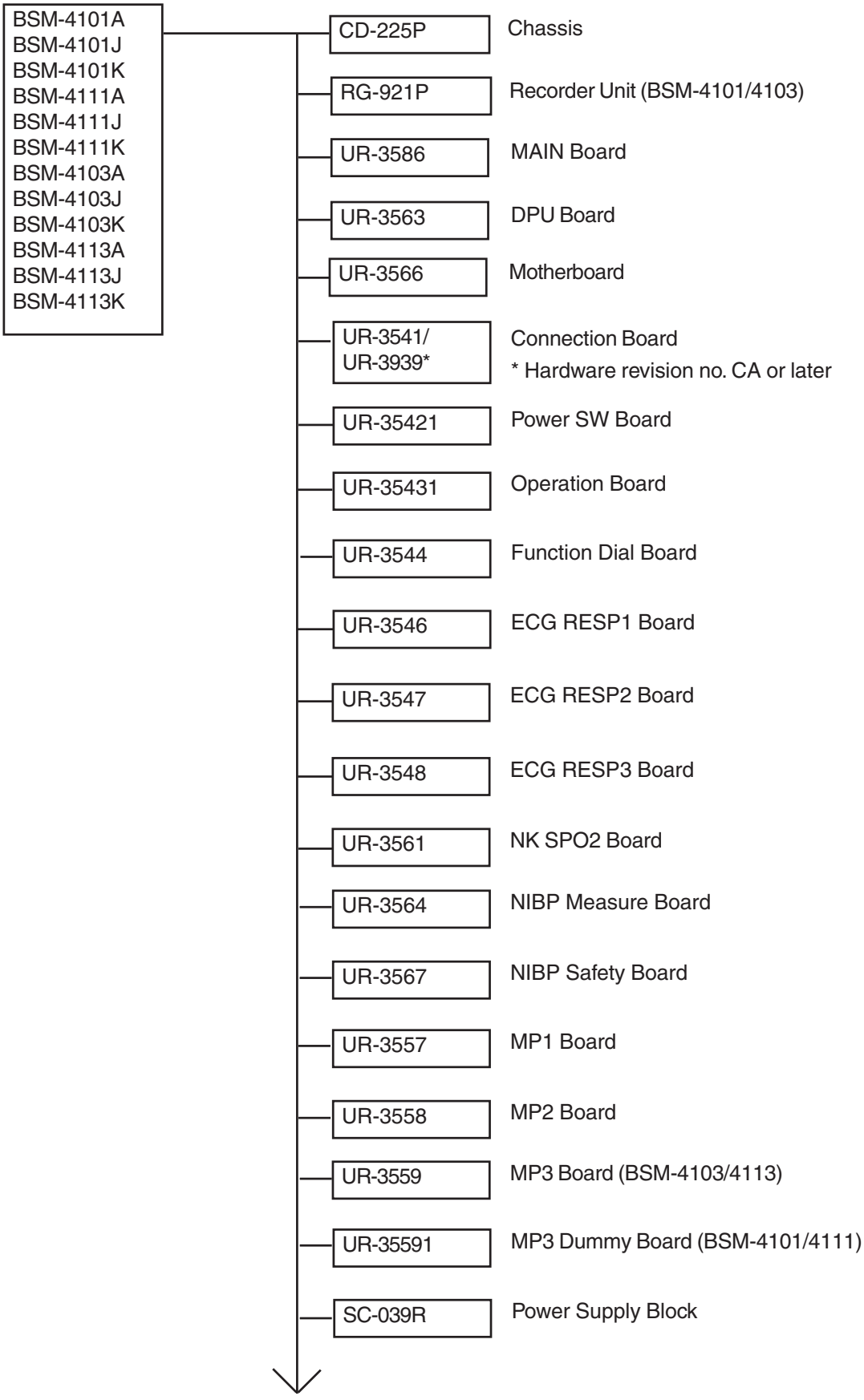
Periodic maintenance procedures and diagnostic check procedures are provided in this manual to ensure that the instrument is operating in accordance with its design and production specifications. To verify that the instrument is working in a safe manner with regard to patient safety, patient safety checks should be performed on the instrument before it is first installed, periodically after installation, and after any repair is made on the instrument.

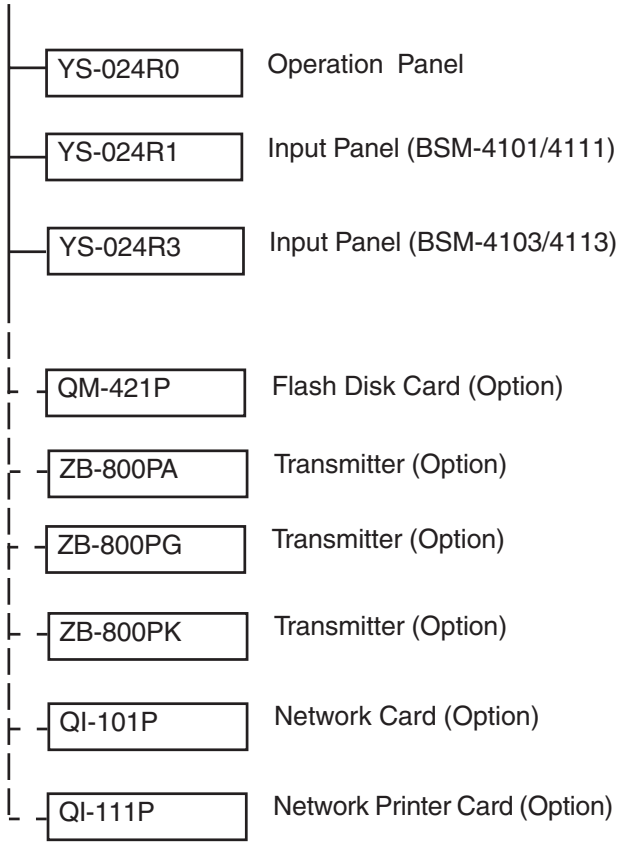
For patient safety checks, perform the following checks as described in the International Electrotechnical Commission's standard, IEC60601-1 (1988):

- Protective earth resistance check
- Earth leakage current check
- Enclosure leakage current check
- Patient leakage current check
- Withstanding voltage check

Composition

BSM-4101/4103/4111/4113




YS-024R0
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YS-024R1
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YS-024R3
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Flash Disk Card (Option)
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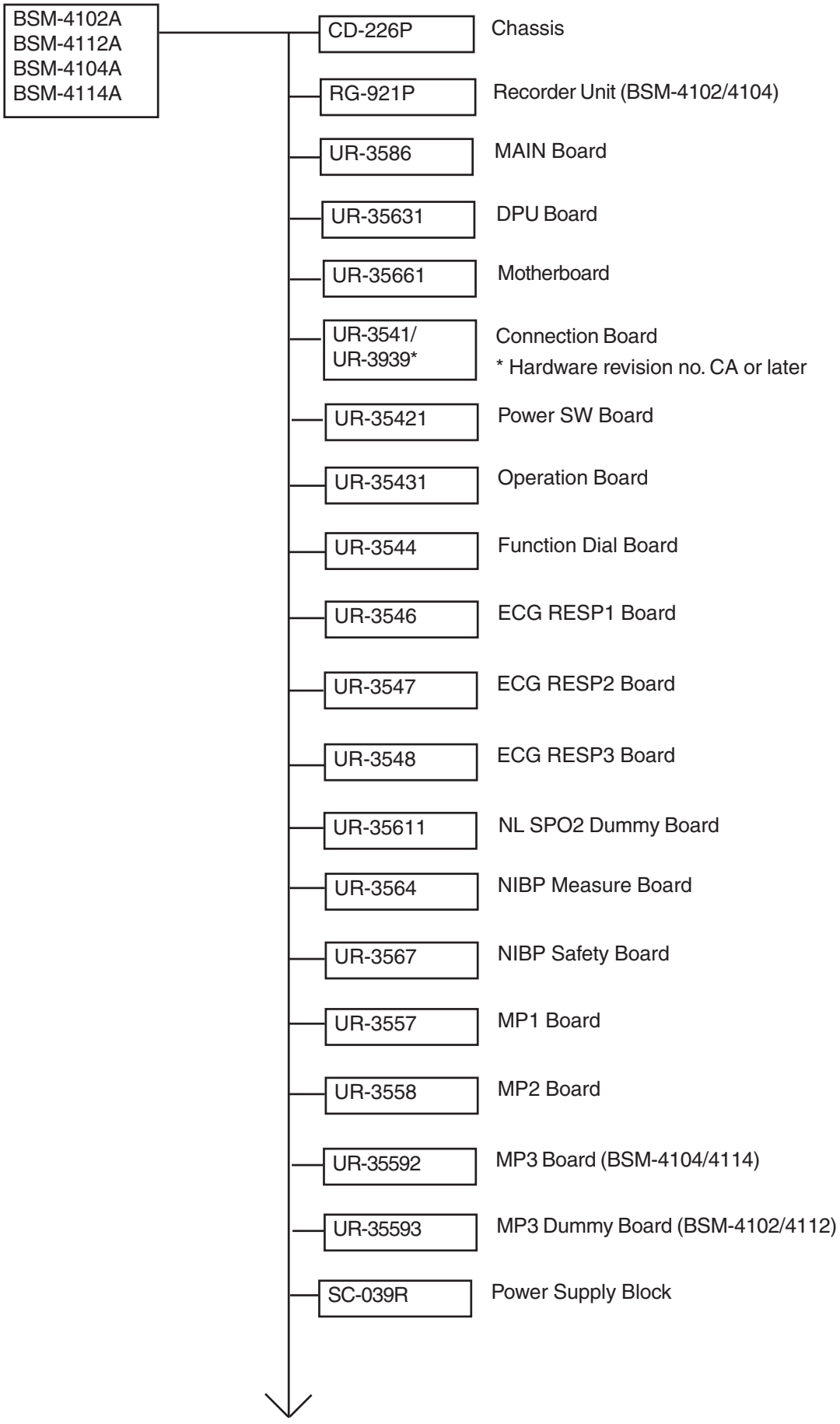
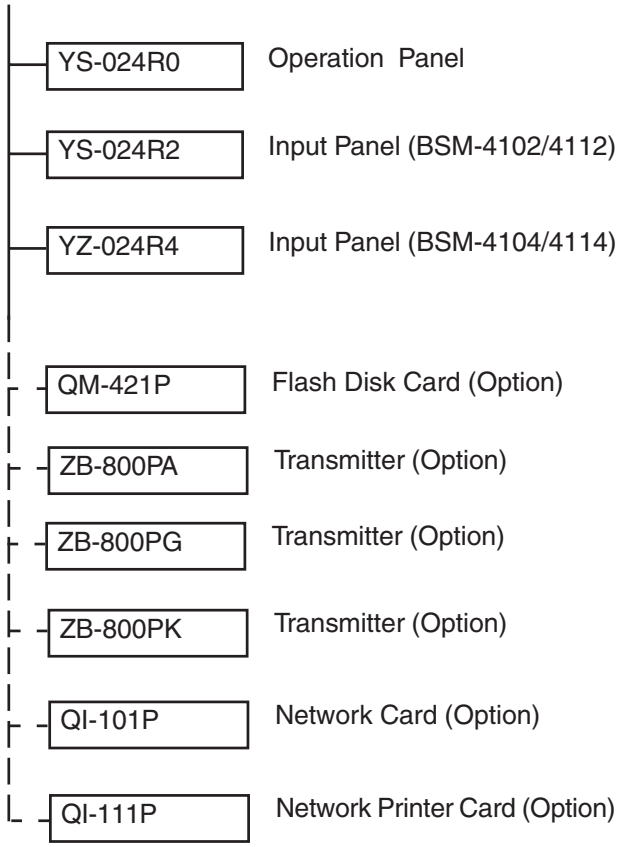
ZB-800PK
Transmitter (Option)
QI-101P
Network Card (Option)
QI-111P
Network Printer Card (Option)

BSM-4102/4104/4112/4114




YS-024R0
Operation Panel
YS-024R2
Input Panel (BSM-4102/4112)
YZ-024R4
Input Panel (BSM-4104/4114)
QM-421P
Flash Disk Card (Option)
ZB-800PA
Transmitter (Option)
ZB-800PG
Transmitter (Option)
ZB-800PK
Transmitter (Option)
QI-101P
Network Card (Option)
QI-111P
Network Printer Card (Option)

Specifications

Display

Display size:	12.1 inch, TFT type LCD
Waveform display mode:	Non-fade moving or non-fade fixed
Viewing area:	246 mm × 184.5 mm
Resolution:	800 × 600 dots
Maximum number of waveform trace:	13 traces (12 lead display)
Sweep speed:	25 mm/s, 50 mm/s (At compressed: 6.25 mm/s, Respiration low speed: 1.56 mm/s)
Sweep time:	7.4 s (at 25 mm/s sweep speed)
Waveform display color:	12
Numeric display color:	12
Waveform freeze:	Provided
Display waveforms:	ECG, respiration, IBP, SpO_2 pulse wave, CO_2 and CO thermodilution curve
Numerical data display:	Heart rate, VPC rate, ST level, respiration rate, IBP (systolic, diastolic, mean), NIBP (systolic, diastolic, mean), SpO_2, pulse rate, temperature, CO, FiO_2, $EtCO_2$, $FiCO_2$
Synchronization mark:	Heart rate sync mark, pulse rate sync mark, respiratory sync mark

Sound

Sound type:	Alarm, synchronization, click
Alarm sound:	3 types (pips, bing bongs, bong)
Synchronization sound:	Pitch variable for IBP and SpO_2

Alarm

Alarm items:	Upper/lower limits alarm, apnea alarm, arrhythmia alarm, connector disconnection alarm, noise alarm, electrode off alarm, waveform detecting alarm, probe off alarm, cuff/hose check alarm, sensor check alarm, low battery alarm, operating environment alarm
Alarm types:	Crisis (red blinking), Warning (yellow blinking), Advisory (yellow lighting)
Alarm indication:	Alarm indicator, highlighted message, alarm sound
Alarm suspend:	Provided

Alarm signal delay in central monitor network: ≤ 4 s

ECG

Electrode offset potential tolerance:	±500 mV
Input dynamic range:	± 5 mV
Internal noise:	≤20 μVp-p (Refer to input)
Common mode rejection ration:	≥90 dB
Input impedance	≥5 MΩ (at 10 Hz)
Input bias current:	≤100 nA
Heart rate count	
Calculation method:	Moving average/Instantaneous beat to beat (selectable)
Counting range:	0, 12 to 300 beats/min (±2 beats/min)
Arrhythmia analysis	
Analysis method:	Template matching method
Number of channels:	1 channel
VPC counting rate:	0 to 99 VPCs/min

Arrhythmia message:	ASYSTOLE, VT, VF, VPC RUN, COUPLET, EARLY VPC, BIGEMINY, FREQ VPC, TACHYCARDIA, BRADYCARDIA, NOISE, Electrode OFF, LEARNING
Arrhythmia recall:	
Number of recall files:	16 With QM-421P flash disk card, 100
Storage time per file:	8 s
ST level measurement:	
Number of measurement channels:	3-electrodes: 1 ch 6-electrodes: 8 ch 10-electrodes: 12 ch
Measuring range:	±2.5 mV
Number of recall files (QM-421P flash disk card required):	500 files for monitoring lead
Pacemaker pulse rejection capability:	0.1 to 2 ms, ±2 to 700 mV ANSI/AAMI EC 13-1992 compatible Pacing pulse detection ON/OFF
Defibrillation-proof:	ECG input protected against 400 J IEC 60601-2-27 17.101 compatible
ESU interference filter:	Provided
Time constant:	0.5 or 3.2 s
AC hum filter:	OFF: 150 ±10 Hz (> −3 dB) ON: 23 ±3 Hz (> −3 dB) ≤ −16 dB (50 Hz or 60 Hz)
Lead:	
3-electrode cable:	I, II, III
6-electrode cable:	I, II, III, aVR, aVL, aVF, 2 from V1 to V6
10-electrode cable:	I, II, III, aVR, aVL, aVF, V1 to V6
Waveform display:	
Display sensitivity:	10 mm/mV ±5% (at ×1 sensitivity)
Sensitivity control:	×1/4, ×1/2, ×1, ×2, ×4, or AUTO
Auto positioning:	Available
Pacing spike display:	Available
Heart rate display update cycle:	Every 3 s or when alarm is generated
Alarm items:	
BSM-4100A:	Upper limit range: 20 to 300 beats/min in 5 beats/min steps, OFF Lower limit range: OFF, 15 to 295 beats/min in 5 beats/min steps
BSM-4100J/K:	Upper limit range: 20 to 300 beats/min in 5 beats/min steps Lower limit range: 15 to 295 beats/min in 5 beats/min steps
Alarm items:	TACHYCARDIA, BRADYCARDIA, ASYSTOLE
12 lead ECG interpretation:	Available when monitoring 12 leads on the BSM-4103/4104/4113/4114 monitors.

Respiration (Transthoracic impedance pneumography)

Measuring impedance available range:	0 to 2 kΩ
Internal noise:	≤0.2 Ω (Refer to input)
Excitor current:	30 ±10 μArms at 31.25 kHz
Frequency response:	0.1 to 3.2 Hz ±1 Hz (−3 dB)
Respiration counter counting range:	0 to 150 breaths/min
Defibrillation proof:	Respiration input protected against 400 J discharge

Waveform display:

Display sensitivity:	10 mm/Ω ±25% (at ×1 sensitivity)
Sensitivity control:	×1/4, ×1/2, ×1, ×2, ×4
Respiration rate display update cycle:	Every 3 s or when alarm is generated

Alarm:

Upper limit range:	2 to 150 breaths/min in 2 breaths/min steps, OFF
Lower limit range:	OFF, 0 to 148 breaths/min in 2 steps
Apnea time:	OFF, 5 to 40 s in 5 s steps

SpO_2 on BSM-4101/4103/4111/4113 Monitors

Measuring range:	50 to 100%
Pulse rate counting range:	0, 12 to 300 beats/min
SpO_2 accuracy:	±2 digits (80% ≤ SpO_2 ≤ 100%)
	±3 digits (50% ≤ SpO_2 < 80%)

SpO_2 display:

Pulse rate display update cycle:	Every 3 s or when alarm is generated
Sync tone modulation:	Change in 20 steps at 81 to 100% SpO_2
Waveform sensitivity:	×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8 or AUTO

Alarm:

Upper limit range:	51 to 100% SpO_2 in 1% SpO_2 steps, OFF
Lower limit range:	OFF, 50 to 99% SpO_2 in 1% SpO_2 steps

SpO_2 on BSM-4102/4104/4112/4114 Monitors

Measuring range:	1 to 100%
Pulse rate counting range:	0, 12 to 300 beats/min

SpO_2 accuracy:

DS-100A:	±3% SpO_2
OXIBAND A/N:	±3% SpO_2
OXIBAND P/I:	±3% SpO_2
RS-10:	±3.5% SpO_2
D-YS:	±3% SpO_2
D-YSE:	±3.5% SpO_2
D-YSPD:	±3.5% SpO_2
D-25/D-25L:	±2% SpO_2
N-25:	±2% SpO_2
I-20:	±2% SpO_2
D-20:	±2% SpO_2
R-15:	±3.5% SpO_2
OXICLIQ I:	±2.5% SpO_2
OXICLIQ P:	±2.5% SpO_2
OXICLIQ A:	±2.5% SpO_2
OXICLIQ N:	±2.5% SpO_2
OXI1-2-3 A/N:	±2.5% SpO_2
OXI1-2-3 P/I:	±2.5% SpO_2

SpO_2 display:

Pulse rate display update cycle:	Every 3 s or when alarm is generated
Sync tone modulation:	Change in 20 steps at 81 to 100% SpO_2
Waveform sensitivity:	×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8 or AUTO

Alarm:

Upper limit range:	51 to 100% SpO_2 in 1% SpO_2 steps, OFF
Lower limit range:	OFF, 50 to 99% SpO_2 in 1% SpO_2 steps

Non Invasive Blood pressure, NIBP

Measuring method:	Oscillometric	
Cuff pressure display range:	0 to 300 mmHg	
Accuracy:	±3 mmHg (0 mmHg ≤ NIBP ≤ 200 mmHg)	
	±4 mmHg (200 mmHg ≤ NIBP ≤ 300 mmHg)	
Safety:		
Maximum pressurization value cuff inflation limiter:		Adult 300 to 330 mmHg
		Neonates 150 to 165 mmHg
Cull inflation time limiter:		Adult 161 to 165 s
		Neonates 81 to 84 s
Measurement mode:	Manual	
	Continuous	
	Periodic: 2, 2.5, 5, 10, 15, 30 min, 1, 2, 4, 8 hr interval, with PWTT	
	PWTT is only available on the BSM-4101/4103/4111/4113 monitors.	
NIBP data display update cycle:	Updated every measurement	
Measurement end sound:	Generated when measurement ends	
Alarm:		
Upper limit range:	15 to 260 mmHg in 5 mmHg steps, OFF	
Lower limit range:	OFF, 10 to 255 mmHg in 5 mmHg steps	

Invasive Blood Pressure, IBP

Measuring range:	−50 to 300 mmHg
Measuring accuracy:	±1 mmHg ±1 digit (−50 mmHg ≤ IBP < 100 mmHg)
	±1% ±1 digit (100 mmHg ≤ IBP ≤ 300 mmHg)
Auto zero balancing range:	±200 mmHg
Auto zero balancing accuracy:	±1 mmHg
Transducer sensitivity:	50 µV/V/10 mmHg
Pulse rate counting range:	0, 12 to 300 beats/min
Pulse rate counting accuracy:	±2 beats/min
Noise:	Within ±1 mmHg
Temperature zero drift:	±0.1 mmHg/1°C
Frequency response:	DC to 20 Hz ±3Hz
	DC to 12 Hz ±3Hz
Display update cycle:	Every 3 or when alarm is generated
BP sync sound:	Provided, systolic value 20 to 120 mmHg, changes in 20 steps every 5 mmHg
Alarm:	
Upper limit range:	2 to 300 mmHg in 2 mmHg steps, OFF
Lower limit range:	OFF, 0 to 298 mmHg steps in 2 mmHg steps

Temperature

Measuring range:	0 to 45°C	
Measuring accuracy:	±0.1°C (25°C ≤ Temp ≤ 45°C)	
	±0.2°C (0°C ≤ Temp < 25°C)	
Temperature drift:	within ±0.005°C /°C	
Temperature range:		
Display range:	0°C to 45°C (32 to 115°F)	
Display update cycle:	Every 3 s	
Alarm:		
Upper limit range:	0.1 to 45°C (32 to 113°F) in 0.1°C (1°F) steps, OFF	
Lower limit range:	OFF, 0 to 44.9°C (31 to 112°F) in 0.1°C (1°F) steps	

Cardiac Output, CO

Measuring method:	Thermodilution method
Measuring range:	
Injectate temperature (Ti):	0°C to 27°C
Blood temperature (Tb):	15°C to 45°C
Thermodilution curve (delta Tb):	0°C to 2.5°C
Cardiac output (CO):	0.1 to 20 L/min
Measuring accuracy:	
Ti:	±0.2°C
Tb 25 to 45°C:	±0.1°C
Tb 15 to 25°C:	±0.2°C
CO:	±5%
Temperature drift:	
Ti:	±0.005°C /°C
Tb:	±0.005°C /°C
Frequency response (delta Tb):	DC to 3 Hz (−3 dB)
Injectate volume range:	3, 5, 10 mL (7F)
	1, 2, 3, 4, 5 mL (5F)

Respiration (Thermistor method)

Respiration rate counting range:	0 to 150 breaths/min
	Apnea, 5 to 40 s
Accuracy:	±2 breath/min
Noise:	Within 2.5 Ω (Refer to input)
Frequency response:	0.1 to 3 Hz (−3 dB)
Waveform display	
Display sensitivity:	10 mm/100 Ω ±10% (at ×1 sensitivity)
Sensitivity control:	×1/4, ×1/2, ×1, ×2, ×4
Respiration rate display update cycle:	Every 3 or when alarm is generated
Alarm:	
Upper limit range:	2 to 150 breaths/min in 2 breaths/min steps, OFF
Lower limit range:	OFF, 0 to 148 breaths/min in 2 breaths/min
Apnea time:	OFF, 5 to 40 s in 5 s steps

Inspired Oxygen Fractional Concentration, FiO_2

Measuring range:	10 to 100% O_2
Accuracy:	±3% full scale (When calibrated at 21% O_2)
	±2% full scale (When calibrated at 100% O_2)
Temperature drift:	±0.12% O_2/°C
FiO_2 display update cycle:	Every 3 s or when alarm is generated
Alarm:	
Upper limit range:	19 to 100% in 1% steps, OFF
Upper limit range:	OFF, 18 to 99% in 1% steps

Expired Carbon Dioxide Tension, CO_2

For the TG-900P/TG-920P/TG-950P CO_2 sensor kit specifications, refer to the kit manual.

Measuring method:	Mainstream (TG-900P/TG-920P: semi quantitative, TG-950P: quantitative)
CO_2 measuring range:	0 to 100 mmHg

CO_2 measuring accuracy:

TG-900P/TG-920P:	±3 mmHg ($0 \leq CO_2 \leq 10$ mmHg)
	±4 mmHg ($10 < CO_2 \leq 40$ mmHg)
	±10% reading ($40 < CO_2 \leq 100$ mmHg)
	(At 1 atmospheric pressure, air inspiration, no condensation)
TG-950P:	±2 mmHg ($0 \leq CO_2 \leq 40$ mmHg)
	±5% reading ($40 < CO_2 \leq 70$ mmHg)
	±7% reading ($70 < CO_2 \leq 100$ mmHg)
	(When no condensation)
Warm-up time:	5 s (minimum)
Response time	
TG-900P:	160 ms (typical) for steps from 10 to 90%
TG-920P:	120 ms (typical) for steps from 10 to 90%
TG-950P:	60 ms (typical) for steps from 10 to 90%
Respiration rate counting range:	
TG-900P/TG-920P:	3 to 150 breaths/min ±10%
TG-950P:	0 to 150 breaths/min ±10%
Respiration rate counting accuracy:	±2 breaths/min
CO_2 value display update cycle:	Every 3 s or when alarm is generated
Alarm:	
Upper limit range:	2 to 99 mmHg in 1 mmHg in 1 steps, OFF
Lower limit range:	OFF, 1 to 98 mmHg in 1 steps
Apnea time:	OFF, 5 to 40 s

Trendgraph

Trend parameters:	Heart rate (or pulse rate), respiration rate, VPC rate, ST level, EVENT, apnea (time), apnea (frequency), SpO_2, NIBP (systolic, diastolic and mean), IBP (systolic, diastolic and mean), temperature, CO_2 and FiO_2
Trend times:	1, 2, 4, 8, and 24 h

Vital Signs List

Parameters:	Heart rate (or pulse rate), VPC rate, ST level, NIBP (systolic, diastolic and mean), SpO_2, IBP (systolic, diastolic and mean), respiration rate, temperature, CO_2 and FiO_2	
Number of files in list:	Periodic vital signs list:	120
	Entries in vital signs list at NIBP measurement:	120
List interval:	Periodic vital signs list:	1, 5, 15, 30 or 60 minutes
	Vital signs list at NIBP measurement:	at NIBP measurement

Hemodynamics List (BSM-4103/4104/4113/4114 monitors only)

Number of files:	8

Full Disclosure (QM-421P flash memory card required)

Storage time:	48 hours

Alarm History

Number of files:	200

ECG/BP Output

Outputs 100 mmHg/V IBP waveform of the IBP connection cord connected to the multi-parameter 1 socket, 1 mV/V ECG waveform and heart rate trigger.

Output impedance	
ECG:	≤100 Ω
BP:	≤100 Ω
Output-waveform	
ECG:	±5.0 V (at 1 mV/V sensitivity)
BP:	–0.5 to +3.0 V(at 100 mmHg/V sensitivity)
Heart rate Trigger:	Open collector output
Frequency response	
ECG:	0.05 to 23 Hz (>–3 dB)
	(Differ in ECG display mode setting)
BP:	≥DC to 20 Hz (>–3 dB)
Sensitivity accuracy	
ECG:	±5%
BP:	±5% (Exclude offset)
Delay	
ECG:	Hum filter off: approx. 2 ms
	Hum filter on: approx. 10 ms
BP:	20 Hz filter: approx. 30 to 35 ms max
HT:	approx. 32 to 64 ms max

Recorder (BSM-4101/4102/4103/4104 monitors only)

Recording method:	Thermal array recording
Number of channels:	3 traces (maximum)
Recording width:	≥48 mm
Paper speed:	25, 50 mm/s
Recording paper:	FQW-50-3-100

External Output

ZB-800PA/PG/PK, ZS-900PG/PK:	Provided
External monitor:	Provided

Clock Accuracy

At operating temperature 25°C:	about ±2 min 40 s/month maximum
At storage temperature –20 to 60°C:	about ±5 min/month maximum

Power Requirement

Line voltage:	
BSM-4100A:	AC 117 V ±10%
BSM-4100J:	AC 100 to 127 V ±10%
BSM-4100K:	AC 220 to 240 V ± 10%
DC (NKB-101):	10.8 to 16.0 ±5%
Line frequency:	
BSM-4100A:	60 Hz ±2%
BSM-4100J/K:	50 or 60 Hz ±2%
Power consumption:	AC: 80 VA maximum
	DC: 50 W maximum

Environment

Operating environment

Temperature:	10 to 40°C
Humidity:	30 to 90% RH (0 to 40°C, non-condensing)
Atmospheric pressure:	68 to 106 kPa

Storage environment

Temperature:	–20 to +65°C
	–15 to +55°C (Recording paper)
Humidity:	15 to 95% RH (0 to 40°C, non-condensing)
Atmospheric pressure:	68 to 106 kPa

Dimensions and Weight (approximate)

Dimensions:	339 mm W × 375 mm H ×159 mm D
Weight:	9 kg (excluding battery)

Electromagnetic Compatibility

IEC60601-1-2: 1993 – Collateral Standard: Electromagnetic compatibility – Requirement and tests

Emissions:	CISPR11 Group 1, Class B

Safety Standard

Safety standard:	IEC 60601-1: 1988 Amendment 1: 1991, Amendment 2: 1995
	IEC 6060-2-27: 1994 - Particular requirements for the safety of electrocardiographic monitoring
	IEC 60601-2-30: 1995 - Particular requirements for the safety of automatic cycling in direct blood pressure monitoring equipment
	IEC 60601-2-34: 1994 - Particular requirements for the safety of direct blood pressure monitoring equipment
	IEC 60601-2-49: 2001 - Particular requirements for the safety of multifunction patient monitoring equipment

According to the type of protection against electrical shock:

CLASS I EQUIPMENT (AC Powered)
Internally Powered EQUIPMENT (BATTERY Powered)

According to the degree of protection against electrical shock

ECG, Respiration (impedance), IBP:	Defibrillator-proof type CF applied part
Temperature, CO:	CF applied part
NIBP:	Defibrillator-proof type BF applied part
SpO_2, Respiration (thermistor), CO_2, FiO_2:	BF applied part

According to the degree of protection against harmful ingress of water:

IPX0 (ordinary EQUIPMENT)

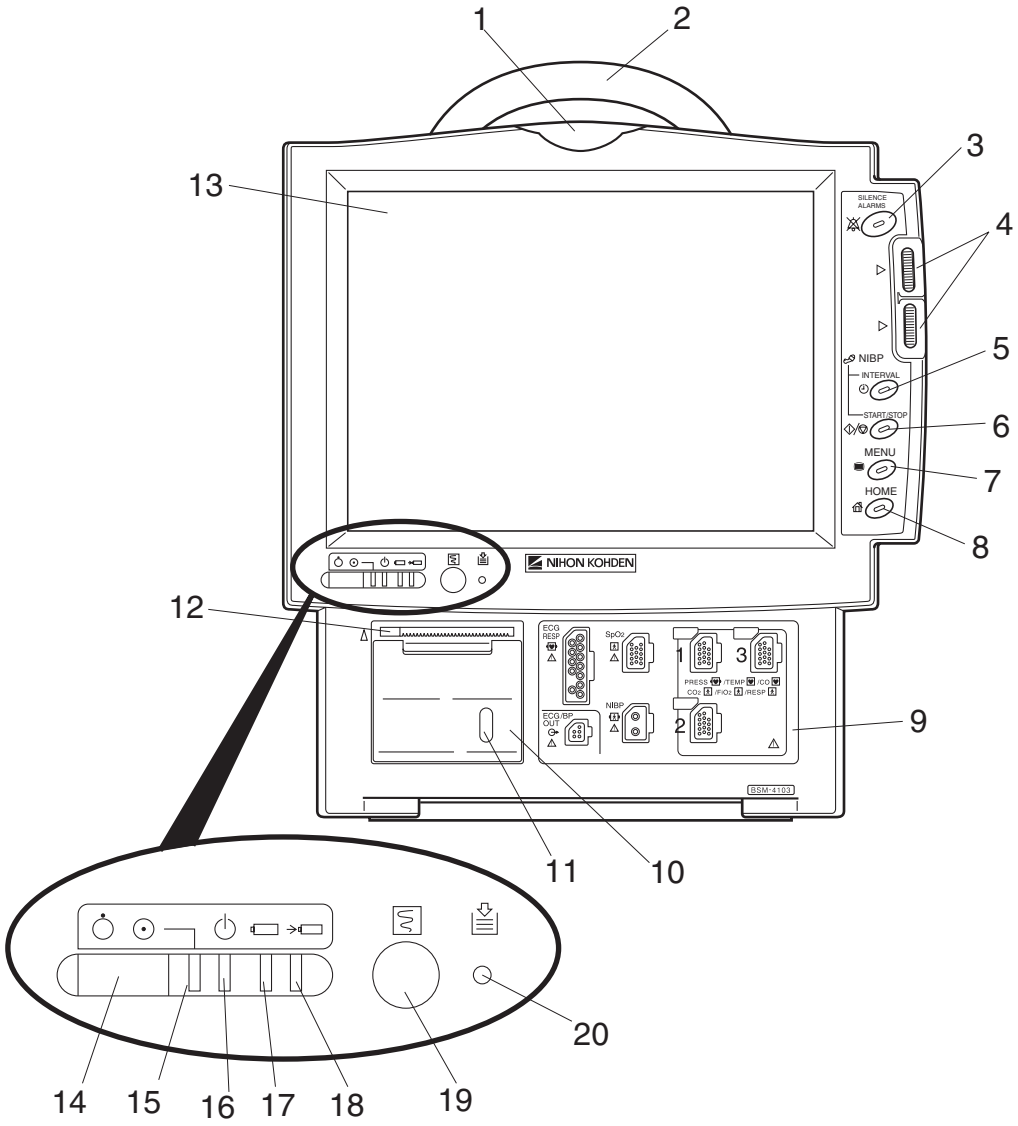
According to the degree of safety of application in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE:

Equipment not suitable for use in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE

According to the mode of operation: CONTINUOUS OPERATION

Names and Function of Parts

Front Panel



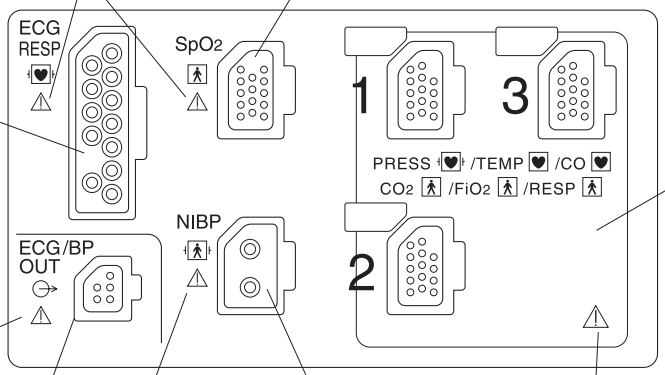
No.	Name	Description
1	Alarm indicator	Red or orange lamp blinks according to the alarm settings. Green lamp blinks in synchronization with the patient's QRS.
2	Handle	For carrying the instrument.
3	SILENCE ALARMS key	Silences the alarm sound.
4	Function dial 1 and 2	Used for setting alarm limits and scrolling list or trendgraphs. When the function dial lamp lights, the function dial is available.
5	NIBP INTERVAL key	Selects NIBP measurement mode. Pressing this key changes the mode.
6	NIBP START/STOP key	Starts NIBP measurement in selected mode. Pressing the key during measurement stops measurement.
7	MENU key	Displays the MENU window.
8	HOME key	Closes any opened window and displays the monitoring screen.
9	Socket panel	Refer to the "Socket Panel" section.
10	Paper magazine	Holds recording paper. (BSM-4101/4102/4103/4104 only)
11	Paper window	For checking the amount of recording paper. (BSM-4101/4102/4103/4104 only)
12	Paper magazine release lever	Pull up the lever to open the paper magazine. (BSM-4101/4102/4103/4104 only)
13	Touch screen	Displays monitoring data. Touching a key or data on the screen changes displaying screen and settings.
14	Power switch	Press and hold for more than one second to turn the instrument power on or off.
15	Power lamp	Lights when the instrument power is turned on.
16	AC power lamp	Lights when the power cord is connected between the AC SOURCE socket and AC outlet.
17	Battery power lamp	Lights when operating on the battery power.
18	Battery charging lamp	Lights or slowly blinks when charging.
19	Record key	Press to start or stop recording.
20	Out of paper lamp	Blinks when out of paper. Lights when paper magazine is open. (BSM-4101/4102/4103/4104 only)

Socket Panel

On the BSM-4101/4103/4111/4113 Monitors

Refer to Warning and Caution in the "General Safety Information" in the operator's manual.

SpO_2 socket
Connects to the SpO_2 connection cord.



ECG/RESP socket
Connects to the ECG connection cord.

Multi-parameter sockets
Connect to the connection cord of the parameter to be monitored (IBP, temperature, CO, CO_2, FiO_2 or respiration by thermistor method). The type of parameter is automatically recognized. BSM-4101/4111 monitors have two sockets and BSM-4103/4113 monitors have three sockets.

Refer to Warning and Note on the next page.

NIBP socket
Connects to the air hose.

Refer to Warning and Note on the next page.

Refer to Warning and Caution in the "General Safety Information" in the operator's manual.

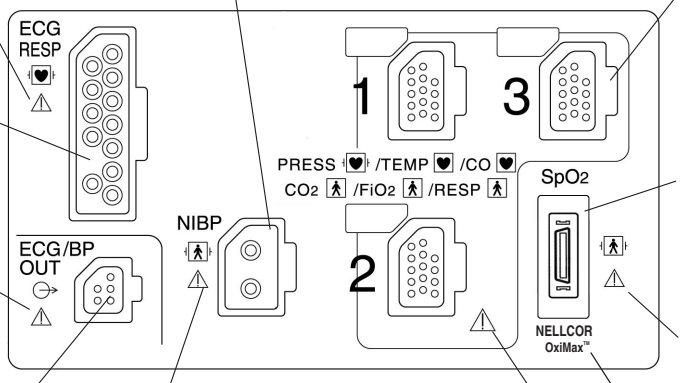
ECG/BP OUT socket
Outputs 100 mmHg/V IBP waveform of the IBP connected to the multi-parameter 1 socket, 1 mV/V ECG waveform and heart rate trigger by using the YJ-910P or YJ-920P ECG/BP output cable. These analog signals can be used as the synchronization signal for other equipment, such as IABP or defibrillator. Refer to the warning on the next page.

On the BSM-4102/4104/4112/4114 Monitors

Multi-parameter sockets
Connect to the connection cord of the parameter to be monitored (IBP, temperature, CO, CO_2, FiO_2 or respiration by thermistor method). The type of parameter is automatically recognized. BSM-4102/4112 monitors have two sockets and BSM-4104/4114 monitors have three sockets.

NIBP socket
Connects to the air hose.

Refer to Warning and Caution in the "General Safety Information" in the operator's manual.



ECG/RESP socket
Connects to the ECG connection cord.

SpO_2 socket
Connects to the SpO_2 connection cord.

Refer to Warning and Note on the next page.

Refer to Warning and Caution in the "General Safety Information" in the operator's manual.

When "NELLCOR OxiMax" is indicated, MP506 SpO_2 module is built in.

Refer to Warning and Note on the next page.

ECG/BP OUT socket
Outputs 100 mmHg/V IBP waveform of the IBP connected to the multi-parameter 1 socket, 1 mV/V ECG waveform and heart rate trigger by using the YJ-910P or YJ-920P ECG/BP output cable. These analog signals can be used as the synchronization signal for other equipment, such as IABP or defibrillator. Refer to the warning on the next page.

Using the Output Signal from the ECG/BP OUT Socket

WARNING

When using the output signal from the monitor as the synchronization signal for other equipment such as an IABP (intra-aortic balloon pump) or defibrillator:

- **Set the timing of the IABP by checking the waveform on the IABP screen.**
- **Check the condition of the bedside monitor at all times. The output signal may become unstable.**
- **Check that the delay time of the output signal (heart rate trigger 64 ms maximum) is within the range of the connected equipment.**
- **Do not use the heart rate trigger as the synchronization signal for defibrillator.**

NOTE

The output signal from the ECG/BP OUT socket may become unstable in the following conditions.

- **Electrode is dry or detached.**
- **Electrode lead is damaged or disconnected from the electrode.**
- **Electrode lead is pulled.**
- **AC interference or EMG noise superimposed.**
- **Air bubbles or blood clog in the circuit for monitoring IBP.**
- **Cord or cable is disconnected or damaged.**

The Delay Time of the Output Signal

Output Signal	Filter Setting	Delay Time
ECG	Hum filter OFF	2 ms
	Hum filter ON	10 ms
IBP	Filter 20 Hz	30 to 35 ms
Heart rate trigger	———	32 to 64 ms

Using Multi-parameter Sockets for CO and CO_2 Monitoring

WARNING

- **When performing defibrillation during CO monitoring, never touch the CO connection cord. Otherwise the discharged energy may cause electrical shock or injury.**
- **When performing defibrillation during CO_2 monitoring with the CO_2 sensor kit, remove the sensor from the patient. If the sensor cannot be removed, do not touch the sensor cable because the discharged energy may cause electrical shock or injury.**

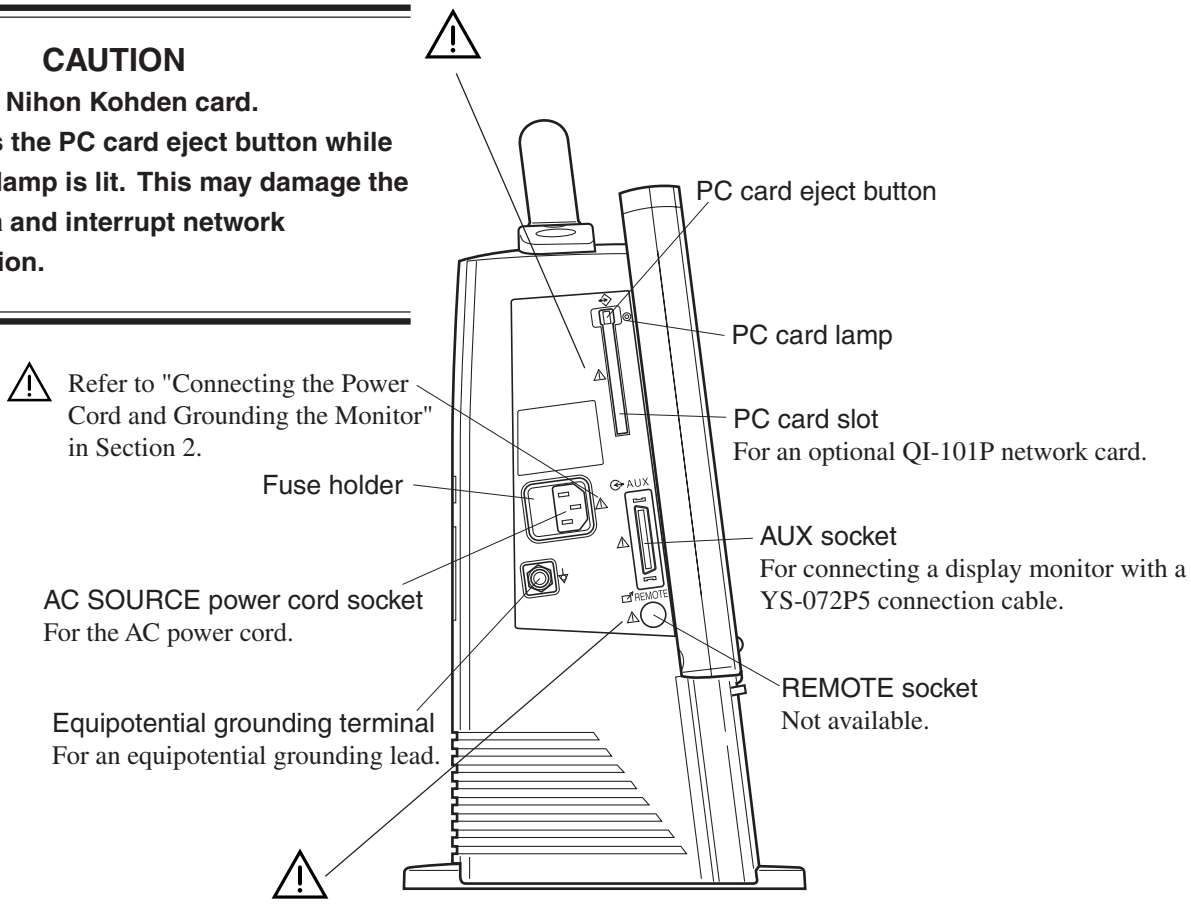
NOTE

- **CO monitoring using the multi-parameter socket does not comply with the Defibrillator proof type CF.**
- **CO_2 monitoring using the multi-parameter socket does not comply with the Defibrillator proof type BF.**

Left Side Panel

CAUTION

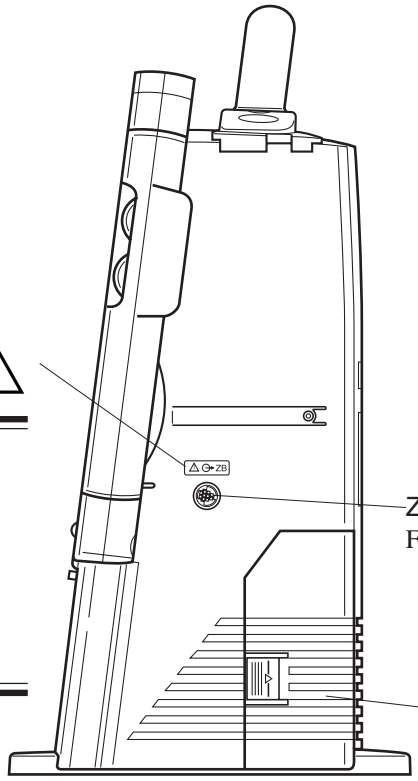
- **Use only the Nihon Kohden card.**
- **Do not press the PC card eject button while the PC card lamp is lit. This may damage the PC card data and interrupt network communication.**


PC card eject button
PC card lamp
Refer to "Connecting the Power Cord and Grounding the Monitor" in Section 2.
PC card slot
For an optional QI-101P network card.
Fuse holder
AUX
AUX socket
For connecting a display monitor with a YS-072P5 connection cable.
AC SOURCE power cord socket
For the AC power cord.
REMOTE
REMOTE socket
Not available.
Equipotential grounding terminal
For an equipotential grounding lead.

WARNING

Connect only the specified instrument to the monitor and follow the specified procedure. Failure to follow this warning may result in electrical shock or injury to the patient and operator, and cause fire or instrument malfunction.

Right Side Panel



CAUTION

Connect only the ZB-800P transmitter to the ZB socket by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.

Storage and Transport

Follow these procedures when storing or transporting the instrument.

Storage

Before storing the instrument for a long time, perform the following steps:

1. Disconnect the power cord from the instrument.
2. Cover the instrument with a dust cover.
3. If possible, store the instrument in its original shipping container.
4. Make sure the storage place meets the following storage conditions for the duration of the storage.
   Storage temperature: –20 to 60°C (–4 to 130°F)
   Storage humidity: 15 to 95% RH, non-condensing

Transport

To transport the instrument, perform the following steps:

1. Disconnect the power cord from the instrument.
2. Cover the instrument with a dust cover.
3. If possible, transport the instrument in its original shipping container.

Hard Keys and Soft Keys

Hard Keys

The instrument has six hard keys: SILENCE ALARMS, NIBP INTERVAL, NIBP START/STOP, MENU, HOME and RECORD.
These keys always have the same functions, regardless of the screen display.
In this manual, hard keys are indicated by CAPITAL LETTERS.

Soft Keys

When the MENU key is pressed or the screen is touched, the screen displays several keys which have different functions depending on the screen display. For example, when the HR numeric display is touched, the ECG setting screen appears and several keys such as VITAL ALARM, ARRHYTH ALARM, OTHER SETTING, etc are displayed.
In this manual, soft keys are indicated by quotation marks (for example, the “VITAL ALARM” key).

Upgrading the System Software and Changing Language on the Screen

CAUTION

Upgrading the system software and changing the language on screen erases all system and monitoring settings. Write down these settings so they can be re-entered after the software upgrade.

The instrument uses a program card for upgrading its system software and changing the screen language. When the instrument detects that a program card is inserted into its PC card slot during the booting stage after it is turned on, it checks the program card for a system program or language. If the program card contains a newer version of the system program or language, the instrument automatically replaces its current system program or language information with the new one. If the program card contains a system program whose version number is the same or older than the one in the instrument, you have the option to replace or keep the current system program. If the program card does not contain a system program, the instrument continues the boot-up process.

In the system software upgrading or language changing process, the instrument first deletes the old system software or language stored in its system ROM. Then it checks whether the data in the system ROM is completely deleted. When the data is completely deleted, it copies the new version of the system program or language information from the program card to the system ROM and then checks the copy process. After the data is successfully copied, it performs the self-check programs to check the equipment.

Procedure

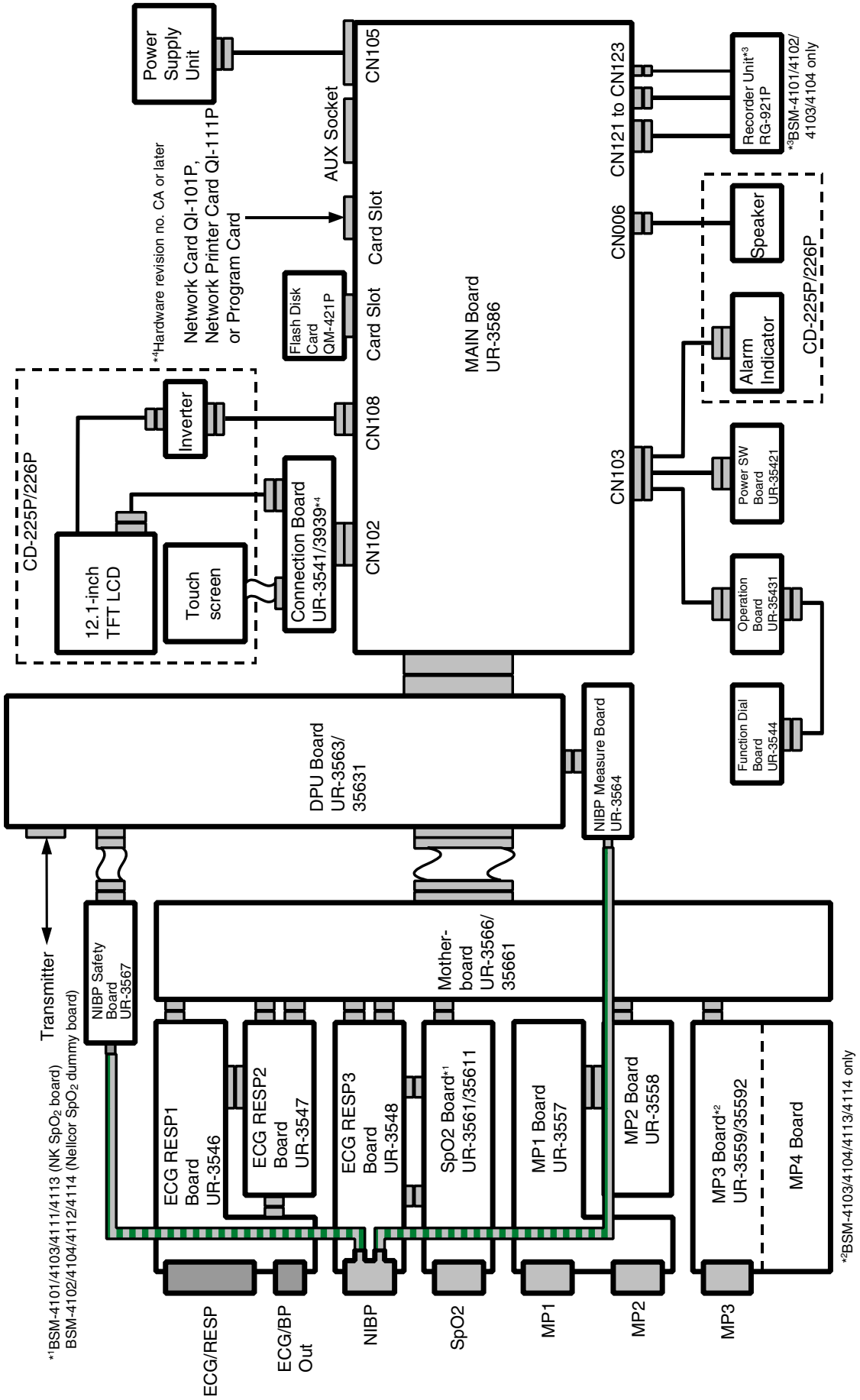
1. Write down the System Setup settings and monitoring settings of the instrument.

2. Insert the program card into the PC card slot on the left side panel of the instrument.

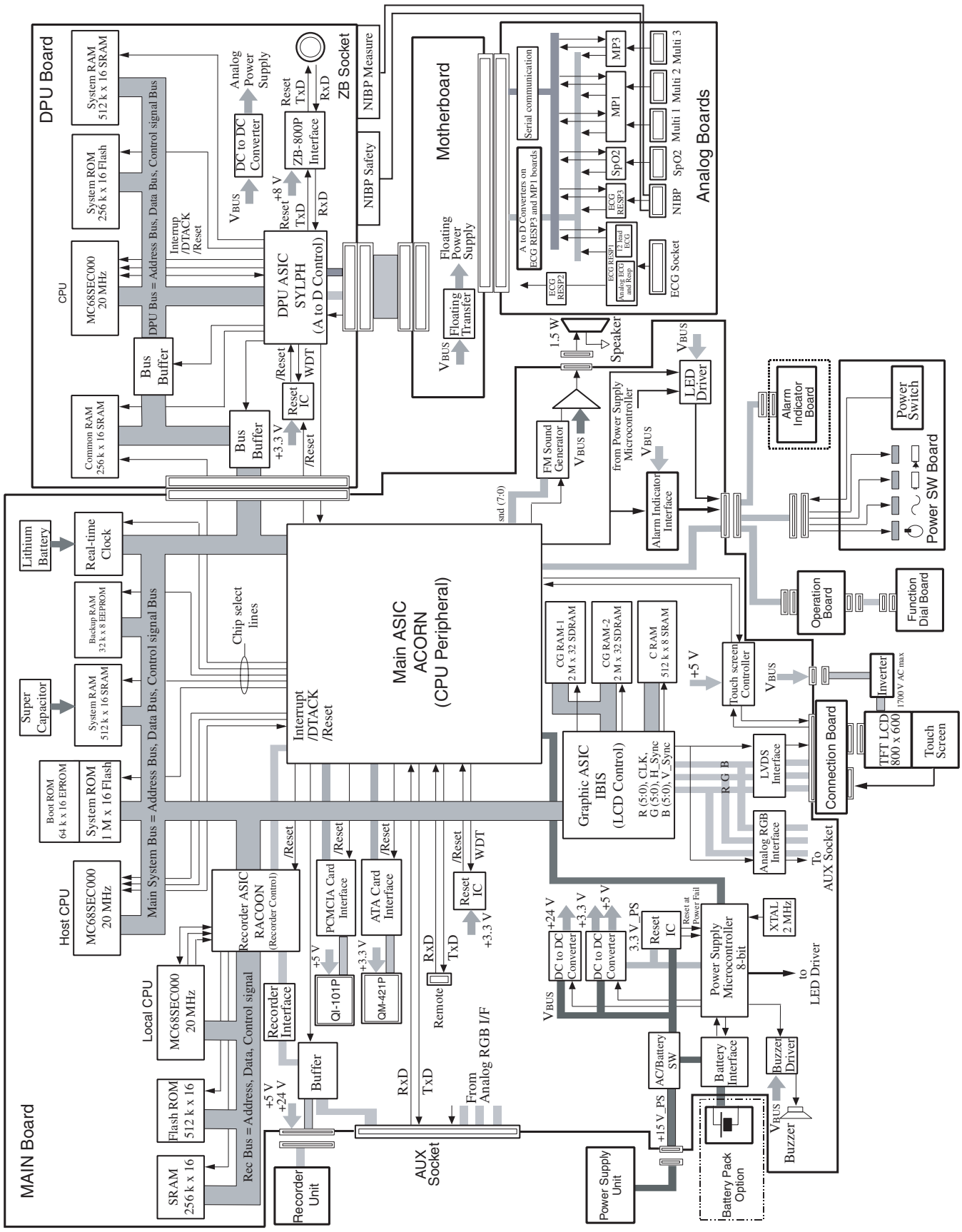
3. Turn on the instrument. The instrument performs the upgrading process and self-check programs. The DIAGNOSTIC CHECK screen appears.

4. Confirm that the new system software version number appears.

Board/Unit Connection Diagram



Block Diagram



Section 2 Troubleshooting

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General

Use the troubleshooting tables to locate, identify, and solve a problem in the instrument. The problems are divided into general problem areas. Each category has its own troubleshooting table for fast and easy troubleshooting.

- Power-related Problems
- Display Problems
- Sound Problems
- Key Function Problems
- Recording Problems
- ECG and Respiration by Impedance Method Problems
- SpO_2 Problems
- NIBP Problems
- Other Vital Sign Input Problems
- ECG/BP Output Problems
- Option Problems

If these sections do not solve the problem, contact your Nihon Kohden representative.

NOTE

Before contacting your Nihon Kohden representative for technical support, please provide additional detailed information on the problem. This will allow your Nihon Kohden representative to provide you with the best support.

How to use the troubleshooting table

1. Determine which troubleshooting table to use.
2. In the “Problem” column, find the trouble item that matches the problem.
3. Do the action recommended in the “Action” column.
4. If the problem is not solved, do the action for the next possible cause or criteria.
5. If none of the actions solve the problem, contact your Nihon Kohden representative.

Power-Related Problems

Problem	Possible Cause/Criteria	Action
No beep sound and AC power lamp does not light in AC power operation.	No AC power input.	Check the AC power input.
	One or both AC inlet fuses is blown.	Remove the cause of the blown fuse, then replace the fuse.
	Faulty connection between CN105 on the MAIN board and power unit.	Check the connection of MAIN board and power unit.
	Faulty connection between CN103 on the MAIN board and power SW board.	Check the connection.
	Faulty power supply unit.	Replace the power supply unit.
	Faulty power SW board.	Replace the power SW board.
No beep sound and the battery power lamp does not light in DC power operation.	The battery is discharged.	Charge the battery before use.
	The battery is damaged.	Replace the battery.
	Faulty cable connection between CN021 on the MAIN board and battery receptacle terminals.	Check the connection.
DC power operation time is shorter than expected.	The battery is near the end of its life (about 1 year).	Replace the battery with a new one.
	Poor contact between the battery and its contact points in the battery compartment.	Clean the contact points between the battery and its compartment terminals.
	The battery has had “memory effect” in which its charge capacity is decreased by frequent incomplete discharging and charging.	To clear this “memory effect”, fully discharge the battery and then fully charge it a few times.
		Replace the battery with a new one.
Power switch is not operational.	Faulty power SW board.	Replace the power SW board.
	Faulty MAIN board.	Replace the MAIN board.

Display Problems

Problem	Possible Cause/Criteria	Action
No display and the backlight does not light.	Faulty connection between CN108 on the MAIN board and inverter.	Check the connections.
	Faulty connection between inverter and LCD unit.	Check the connections.
	Faulty inverter board.	Replace the inverter board.
	Faulty backlight lamps.	Replace the backlight lamps.
No display, but the backlight lights.	Faulty connection between CN102 on the MAIN board and CN102 on the connection board.	Check the connection.
	Faulty connection between CN103 on the connection board and LCD unit.	Check the connection.
	Faulty LCD unit.	Replace the LCD unit.
	Faulty MAIN board.	Replace the MAIN board.
Fine vertical or horizontal lines on the LCD.	Faulty LCD unit.	Replace the LCD unit.
	Faulty MAIN board.	Replace the MAIN board.
Thick vertical or horizontal stripes on the screen.	Faulty MAIN board.	Replace MAIN board.
The characters or waveforms are distorted.	Faulty MAIN board.	Replace the MAIN board.
	Faulty connection between CN102 on the MAIN board, connection board and LCD.	Check the connection.
The display is dim and the brightness control does not make it brighter.	Battery operation.	Set the POWER SAVE MODE to OFF on the SYSTEM SETUP screen.
	Dirt on the touch screen (inside or outside).	Clean the surface of touch screen.
	The backlight lamps are near the end of its useful life. 25,000 hours for revision no. before CA 50,000 hours for revision no. CA or later	Replace the backlight lamps.
	Faulty connection between CN108 on the MAIN board and inverter board.	Check the connection.
The Diagnostic Check screen appears in the monitor mode and “OK” is displayed at the POWER ON CHECK RESULT.	Faulty Operation board.	Replace the Operation board.
	Faulty MAIN board.	Replace the MAIN board.
The Diagnostic Check screen appears in the monitor mode and an error message is displayed at the POWER ON CHECK RESULT. Refer to “Power On Self Check” in Section 3.	Faulty MAIN board.	Replace the MAIN board.
	Faulty DPU board.	Replace the DPU board.
The screen with a “Check Program Running” message does not change to the next screen after the power is turned on.	Software bug.	Perform the system initialization.
	Faulty MAIN board.	Replace the MAIN board.
	Faulty DPU board.	Replace the DPU board.
System error information appears at the upper left corner on the screen in the monitor mode and the instrument restarts.	Faulty MAIN board.	Replace the MAIN board.
	Faulty DPU board.	Replace the DPU board.
More than 25 pixels on the screen do not light or have abnormal color. Note that up to 25 pixels with such a problem is considered normal.	Faulty LCD unit.	Replace the LCD unit.
No waveform is displayed but the connection cord for each vital sign is recognized.	Faulty MAIN board.	Replace the MAIN board.
No waveform is displayed and the connection cord for each vital sign is not recognized.	Refer to each vital sign troubleshooting section.	Refer to each vital sign troubleshooting section.

Sound Problems

Problem	Possible Cause/Criteria	Action
No sound.	Faulty connection between CN006 on the MAIN board and the speaker.	Check the connection.
	Faulty speaker.	Replace the speaker.
	Faulty MAIN board.	Replace the MAIN board.
No sound, except for a hissing sound.	Faulty MAIN board.	Replace the MAIN board.
	Faulty speaker.	Replace the speaker.
The sound is muffled or distorted.	The speaker is blocked.	Remove the object blocking the speaker.
	Something foreign is touching the speaker.	Remove the foreign matter.
	The speaker is wrongly attached.	Attach the speaker correctly.

Key Operation Problems

Problem	Possible Cause/Criteria		Action
No key on the front panel works.	Faulty connection between CN102 on the Operation board and CN103 on the MAIN board.		Check the connection.
	Faulty MAIN board.		Replace the MAIN board.
	Faulty Operation board.		Replace the Operation board.
A specified key on the operation panel does not work.	Faulty connection cable between CN102 on the Operation board and CN103 on the MAIN board.		Replace the connection cable.
	Faulty Operation board.		Replace the Operation board.
	Faulty MAIN board.		Replace the MAIN board.
The workable key area does not match the key display on the screen.	Incorrect calibration of the touch screen.		Calibrate the touch screen positioning.
	Faulty connection between the touch screen and Connection board.		Check the connection.
	Faulty connection between connection board and MAIN board.		Check the connection.
Touch screen does not work.	The key function on the entire screen does not work.	Faulty connection between the touch screen and CN102 on the Connection board.	Check the connection.
		Faulty MAIN board.	Replace the MAIN board.
		Faulty touch screen.	Replace the touch screen.
	The key function on a partial screen such as upper half screen does not work	Faulty touch screen.	Replace the touch screen.
Function dials are not operational.	Faulty connection between the Operation board and Function Dial board.		Check the connection.
	Faulty Function Dial board.		Replace the Function Dial board.
	Faulty MAIN board.		Replace the MAIN board.

Recording Problems

Problem	Possible Cause/Criteria		Action
Recording paper does not feed properly.	Recording mark does not appear on the screen when the record key is pressed.	Faulty connection between CN103 on the MAIN board and Power SW board.	Check the connection.
		Faulty Power SW board.	Replace the Power SW board.
		Faulty MAIN board.	Replace the MAIN board.
	Paper magazine open mark appears on the screen.	Faulty connection between CN122 on the MAIN board and recorder unit	Check the connection.
		Faulty magazine position sensing micro switch of the recorder unit.	Replace the micro switch. Refer to Section 8 “Replaceable Parts List”.
		Faulty MAIN board.	Replace the MAIN board.
	Out of paper mark appears on the screen.	Faulty connection between CN122 on the MAIN board and recorder unit.	Check the connection.
		Faulty paper detection photo sensor or LED of the reorder unit.	Replace the photo sensor and LED. Refer to Section 8 “Replaceable Parts List”.
		Faulty MAIN board.	Replace the MAIN board.
	Recording can be performed when the paper is manually pulled out after the record key is pressed.	Faulty connection between CN122 on the MAIN board and recorder unit.	Check the connection.
		Faulty paper drive motor of the recorder unit.	Replace the motor. Refer to Section 8 “Replaceable Parts List”.
		Faulty MAIN board.	Replace the MAIN board.
For page-dependent recording such as trendgraph and vital sign list, the recording does not start at the top of the page	Wrong position of the recording paper in the magazine.		Load the paper into the magazine correctly.
	Paper other than Nihon Kohden is used.		Use the Nihon Kohden paper.
	Photo sensor for detection of the black square on the paper is dirty.		Clean the sensor.
	Faulty connection between CN122 on the MAIN board and recorder unit.		Check the connection.
	Faulty black square detection photo sensor or LED of the recorder unit.		Replace the photo sensor and LED. Refer to Section 8 “Replaceable Parts List”.
	Faulty MAIN board.		Replace the MAIN board.
The recorded data such as waveform and grid has a faint part on the paper.	Thermal array head is dirty		Clean the head.
	Paper other than Nihon Kohden is used.		Use the Nihon Kohden paper.
	Platen roller has a damage or is deformed.		Replace the roller.
	The supply voltage for thermal array head (+24 V DC) decreases.		Replace the MAIN board.
There is missing dots on the recorded data.	Faulty thermal array head if the dots are missed at the same position on the paper after the head is cleaned.		Replace the head.
Straight line is recorded at the same position on the paper.	Faulty thermal array head or recorder unit after head is cleaned.		Replace the head or recorder unit.
There is different contrast between the upper half and lower half of the paper.	The thermal array head is incompletely attached to the recorder unit.		Attach the head correctly.
The paper speed is unstable and waveform is compressed or extended on time scale.	Dirty gear or platen roller.		Clean the gear and platen roller.
	Faulty gear or platen roller		Replace the faulty one.
	Unstable turn of the paper drive motor	Faulty MAIN board	Replace the MAIN board.
		Faulty motor	Replace the motor.
Abnormally loud rotating sound of the paper drive motor	Faulty gear or platen roller		Replace the faulty one.
No recording on the paper	The heat-sensitive side of the paper is not faced to the thermal array head.		Load the paper into the magazine correctly.
	Paper other than Nihon Kohden is used.		Use the Nihon Kohden paper.
	Faulty connection between CN121 on the MAIN board and recorder unit.		Check the connection.
	The supply voltage for thermal array head (+24 V DC) decreases.		Replace the MAIN board.
	Faulty thermal array head.		Replace the head.

ECG and Respiration by Impedance Method Problems

Problem	Possible Cause/Criteria	Action
ATTACH ELECTRODES message is displayed even after each electrode contact part of the electrode lead is short-circuited.	The setting, Number of electrodes, is set to a higher number than the actual number of the electrodes.	Set the number of electrodes correctly.
	The electrode lead, ECG connection cord or patient cable is faulty.	Replace the accessory with a new one.
	ECG RESP1 board, ECG RESP2 board or ECG RESP3 board is faulty.	Replace the ECG input block with a new one*.
The time constant setting cannot be changed.	The ECG RESP3 board is faulty if the monitoring lead setting can be changed.	Replace the ECG input block with a new one*.
	Motherboard, DPU board or ECG RESP3 board is faulty if the monitoring lead setting cannot be changed.	Replace the ECG input block or DPU board with a new one*.
Pacing spike is not detected.	ECG RESP2 board, motherboard or DPU board is faulty if the pacing spike detection setting, PACING REJECT, is set to on.	Replace the ECG input block or DPU board with a new one*.
	ECG RESP3 board is faulty if the pacemaker rhythm is not recognized in the 12 lead ECG interpretation.	Replace the ECG input block with a new one*.
The ECG waveform is displayed with a different ECG sensitivity from the sensitivity setting.	ECG RESP1 board is faulty if the ECG waveform at a specified lead is displayed with a different sensitivity from the sensitivity setting.	Replace the ECG input block with a new one*.
	ECG RESP2 board or ECG RESP3 board is faulty if the ECG waveform at all the leads is displayed with a different sensitivity from the sensitivity setting.	
Monitoring lead setting cannot be changed but the time constant setting can be changed.	ECG RESP1 board, ECG RESP2 board or ECG RESP3 board is faulty.	Replace the ECG input block with a new one*.
Display of 12 lead ECG has something wrong.	ECG RESP3 board or motherboard is faulty if no 12 lead ECG waveforms are displayed in the 12 LEAD window.	Replace the ECG input block with a new one*.
	ECG RESP1 board, ECG RESP2 board or ECG RESP3 board is faulty if a specified lead of the 12 lead ECG waveforms is not displayed in the 12 LEAD window	
Respiration waveform is not displayed.	Electrode, electrode lead, ECG connection cord or patient cable is faulty if the ECG waveform on the screen has something wrong.	Replace the accessory with a new one.
	ECG RESP1 board, ECG RESP2 board, motherboard or DPU board is faulty if the ECG waveform on the screen has nothing wrong.	Replace the ECG input block or DPU board with a new one*.
Respiration rate is wrong and the respiration sensitivity is out of control.	ECG RESP1 board or ECG RESP2 board is faulty.	Replace the ECG input block with a new one*.
ECG waveform and respiration waveform are mixed.	Motherboard or DPU board is faulty.	Replace the ECG input block or DPU board with a new one*.
Respiration waveform is saturated and does not return to the baseline position but the sensitivity is not too high.	ECG RESP2 board is faulty.	Replace the ECG input block with a new one*.

* ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.

SpO_2 Problems

Problem	Possible Cause/Criteria	Action
The instrument does not recognize the NK SpO2 connection cord connected to the SpO2 socket on the instrument.	NK SpO2 board or motherboard is faulty or contact between them is poor if the ECG, impedance method respiration and NIBP measurements are enabled.	Check the connection. Replace the NK SpO2 or ECG input block with a new one* if the connection has no problem.
	DPU board is faulty if the ECG, impedance method respiration and NIBP measurements are disabled.	Replace the faulty board with a new one.
PULSE SEARCH message is displayed even after the probe is replaced and attachment site is changed.	NK SpO2 board is faulty.	Replace the faulty board with a new one.
WEAK PULSE message is displayed even after the probe is replaced and attachment site is changed.	NK SpO2 board is faulty.	Replace the faulty board with a new one.
SpO2 MODULE ERROR message is displayed.	SpO2 module (Nellcor) is faulty or connection between the motherboard and SpO2 module is poor if this error message is displayed, except in the following case.	Check the connection. Replace the faulty module with a new one if the connection has no problem.
	If the Nellcor SpO2 connection cord is connected to or disconnected from the SpO2 socket just after the instrument is turned on, it displays this error message at the power on check.	Connect the SpO2 connection cord and turn off the instrument. Turn on the instrument 10 seconds or more after the power is turned off.

* ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.

Non-invasive Blood Pressure Problems

Problem	Possible Cause/Criteria	Action
NIBP MODULE FAILURE message is displayed.	DPU board or NIBP Safety board is faulty.	Replace the faulty board with a new one.
NIBP SAFETY CIRCUIT RUNNING message is displayed.	Air hose is blocked.	Check the air hose.
	Air tube between the NIBP Safety board and NIBP socket is blocked or NIBP Safety board or DPU board is faulty if this message appears soon after the NIBP START/STOP key is pressed and NIBP pump sounds like it's moving.	Check the air tube connection. Replace the faulty board with a new one if the air tube is not blocked.
	Air tube between the NIBP Measure board and NIBP socket is blocked or NIBP Safety board or DPU board is faulty if this message appears in a minute after the NIBP START/STOP key is pressed and NIBP pump sounds like it's moving.	
AIR LEAK message is displayed.	Cuff or air hose has an air leak.	Replace the cuff or air hose with a new one.
	Air tube between the NIBP Safety board and NIBP socket is loose or disconnected if the cuff is not inflated when the NIBP pump sounds like it's moving.	Check the air tube connection.
	Air tube between the NIBP Measure board and NIBP socket is loose or disconnected or NIBP Safety board is faulty if the cuff is inflated when the NIBP pump sounds like it's moving.	Check the air tube connection. Replace the faulty board with a new one if the air tube connection has no problem.
The instrument does not recognize the air hose connected to the NIBP socket on the instrument.	The air hose connector is faulty.	Replace the air hose with a new one.
	ECG RESP3 board or NIBP Safety board is faulty or there is poor contact from the ECG RESP3 board to NIBP Safety board if the ECG and impedance method respiration can be measured.	Check the connection from ECG RESP3 board to NIBP Safety board through the motherboard and DPU board. Replace the faulty board with a new one if the connection has no problem.
	ECG RESP3 board, motherboard or DPU board is faulty or there is a poor contact from the ECG RESP3 board to DPU board if the ECG and impedance method respiration cannot be measured.	Check the connection from the ECG RESP3 board to DPU board through the motherboard. Replace the faulty board with a new one if the connection has no problem.
NIBP measurement data on the screen is wrong.	A wrong cuff size is used or the condition of the cuff wrapped around the patient's arm is not correct.	Check the cuff size and the wrapping condition.
	DPU board is faulty if the ECG, impedance method respiration and SpO_2 cannot be measured.	Replace the faulty board with a new one.
	NIBP Measure board or DPU board is faulty or there is a poor contact between the two boards if the ECG, impedance method respiration and SpO_2 can be measured.	Check the connection between the two boards. Replace the faulty board with a new one if the connection has no problem.
The cuff does not inflate when the NIBP START/STOP key is pressed.	If a message is displayed on the screen, follow the message to solve the problem.	Refer to ERROR MESSAGES AND TROUBLESHOOTING section in the operator's manual.
	The Operation board, MAIN board or the cable between the two boards is disconnected if there is no message on the screen.	Check the cable connection. Replace the faulty board with a new one if the cable connection has no problem.

Other Vital Sign Input Problems

Problem	Possible Cause/Criteria	Action
The instrument does not recognize a connection cord at a multi-parameter socket.	The connection cord is faulty.	Replace the connection cord with a new one.
	The MP2 board is faulty if the connection cord is not recognized at any multi-parameter sockets.	Replace the faulty board with a new one.
	The MP3 board or MP2 board is faulty if the connection cord is not recognized at the No. 3 multi-parameter socket.	
	The MP1 board or MP2 board is faulty if the connection cord is not recognized at the No. 1 or No. 2 multi-parameter socket.	
MPU MODULE ERROR message is displayed.	The connection cable between the motherboard and DPU board is disconnected or the MP2 board, motherboard or DPU board is faulty if this message always appears even after the instrument is turned off and on again.	Check the cable connection. Replace the MP2 board, ECG input block or DPU board with a new one* if the cable connection has no problem.
	The MP2 board is faulty if this message sometimes appears after the instrument is turned off and on again.	Replace the board with a new one.
MPU FAILURE message is displayed.	The EEPROM in the connector of the connection cord is faulty if the cord connected to any multi-parameter sockets displays this message.	Replace the connection cord with a new one.
	The MP3 board or MP2 board is faulty if the cord connection to No. 3 multi-parameter socket only displays this message.	Replace the faulty board with a new one.
	The MP1 board or MP2 board is faulty if the cord connection to No. 1 or No. 2 multi-parameter socket only displays this message.	
Any input parameters for the multi-parameter socket cannot be measured at any multi-parameter sockets.	The MP2 board is faulty if there is no error message on the screen when the connection cord is connected to the multi-parameter socket.	Replace the faulty board with a new one.
Invasive blood pressure cannot be measured.	The blood pressure transducer or connection cord is faulty.	Replace the faulty blood pressure transducer or connection cord with a new one.
	The MP1 board or MP2 board is faulty if the blood pressure cannot be measured at any multi-parameter sockets or can be measured at one of them.	Replace the faulty board with a new one.
	The MP3 board, MP2 board or motherboard is faulty if the blood pressure cannot be measured at the No. 3 multi-parameter socket only.	Replace the MP3 board, MP2 board or ECG input block with a new one*.
	The MP1 board or MP2 board is faulty if the blood pressure cannot be measured at the No. 1 and No. 2 multi-parameter sockets.	Replace the faulty board with a new one.
CHECK SENSOR message is displayed.	The blood pressure transducer is faulty.	Replace the faulty blood pressure transducer with a new one.
	The MP1 board or MP2 board is faulty if the normal transducer connected to each multi-parameter socket through the connection cord displays this message or the blood pressure can be measured at one of them.	Replace the faulty board with a new one.
	The MP3 board, MP1 board or motherboard is faulty if the normal transducer connected to the No. 3 multi-parameter socket only displays this message.	Replace the MP3 board, MP1 board or ECG input block with a new one*.
	The MP1 board or MP2 board is faulty if the normal transducer connected to the No. 1 or No. 2 multi-parameter socket displays this message.	Replace the faulty board with a new one.

* ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.

Problem	Possible Cause/Criteria	Action
IBP measurement data on the screen is wrong.	The blood pressure transducer is faulty.	Replace the faulty blood pressure transducer with a new one.
	The MP2 board or MP1 board is faulty if the blood pressure data is wrong at all the multi-parameter sockets and temperature, FiO_2 and respiration rate (thermistor method) are not wrong at any multi-parameter sockets.	Replace the faulty board with a new one.
	The MP2 board is faulty if not only the blood pressure data but also temperature, FiO_2 and respiration rate are wrong at all the multi-parameter sockets.	
	The MP1 board is faulty if the blood pressure data is wrong at the No. 1 and No. 2 multi-parameter sockets.	
	The MP3 board is faulty if the blood pressure data is wrong at the No. 3 multi-parameter socket only.	
Temperature cannot be measured.	The thermistor probe is faulty.	Replace the faulty probe with a new one.
	The MP2 board is faulty if the T1 and T2 temperatures cannot be measured but thermistor method respiration and FiO_2 can be measured at all the multi-parameter sockets or the temperatures can be measured at one of the multi-parameter sockets.	Replace the faulty board with a new one.
	The MP1 board is faulty if the T1 and T2 temperatures and thermistor method respiration cannot be measured at any multi-parameter sockets.	
	The MP3 board, MP2 board or motherboard is faulty if the T1 and T2 temperatures cannot be measured at the No. 3 multi-parameter socket only.	Replace the MP3 board, MP2 board or ECG input block with a new one*.
	The MP1 board or MP2 board is faulty if the T1 and T2 temperatures cannot be measured at the No. 1 and No. 2 multi-parameter sockets.	Replace the faulty board with a new one.
Temperature measurement data on the screen is wrong.	The thermistor probe is faulty.	Replace the faulty probe with a new one.
	The MP2 board is faulty if the T1 and T2 temperatures are wrong but thermistor method respiration and FiO2 data are not wrong at any multi-parameter sockets.	Replace the faulty board with a new one.
Respiration by thermistor method cannot be measured.	The respiration pickup (thermistor probe) is faulty.	Replace the faulty pickup with a new one.
	The MP1 board or MP2 board is faulty if the thermistor method respiration cannot be measured but the T2 temperature can be measured at all the multi-parameter sockets or the respiration can be measured at one of the multi-parameter sockets.	Replace the faulty board with a new one.
	The MP1 board is faulty if the thermistor method respiration and T1 and T2 temperatures cannot be measured at any multi-parameter sockets.	
	The MP3 board, MP1 board or motherboard is faulty if the thermistor method respiration cannot be measured at the No. 3 multi-parameter socket only.	Replace the MP3 board, MP1 board or ECG input block with a new one*.
	The MP1 board or MP2 board is faulty if the thermistor method respiration cannot be measured at the No. 1 and No. 2 multi-parameter sockets.	Replace the faulty board with a new one.
Thermistor method respiration waveform has something wrong on the screen.	The respiration pickup (thermistor probe) is faulty.	Replace the faulty pickup with a new one.
	The MP1 board or MP2 board is faulty if the respiration rate is wrong but T2 temperature data is not wrong at any multi-parameter sockets.	Replace the faulty board with a new one.

* ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.

Problem	Possible Cause/Criteria	Action
FiO_2 cannot be measured.	The O_2 sensor or connection cord is faulty.	Replace the faulty O_2 sensor or connection cord with a new one.
	The MP2 board is faulty if the FiO_2 cannot be measured but the T1 temperature can be measured at all the multi-parameter sockets or the FiO_2 can be measured at one of the multi-parameter sockets.	Replace the faulty board with a new one.
	The MP3 board, MP2 board or motherboard is faulty if the FiO_2 cannot be measured at the No. 3 multi-parameter socket only.	Replace the MP3 board, MP2 board or ECG input block with a new one*.
	The MP1 board or MP2 board is faulty if the FiO_2 cannot be measured at the No. 1 and No. 2 multi-parameter sockets.	Replace the faulty board with a new one.
FiO_2 data on the screen is wrong.	The O_2 sensor is faulty.	Replace the faulty probe with a new one.
	The MP2 board is faulty if the FiO_2 is wrong but T2 temperature data is not wrong at any multi-parameter sockets.	Replace the faulty board with a new one.
CO_2 cannot be measured.	The CO_2 sensor or CO_2 adapter is faulty.	Replace the faulty CO_2 sensor or adapter with a new one.
	The MP2 board is faulty if the CO_2 cannot be measured at any multi-parameter sockets or can be measured at one of them.	Replace the faulty board with a new one.
	The MP3 board, MP2 board or motherboard is faulty if the CO_2 cannot be measured at the No. 3 multi-parameter socket only.	Replace the MP3 board, MP2 board or ECG input block with a new one*.
	The MP1 board or MP2 board is faulty if the CO_2 cannot be measured at the No. 1 and No. 2 multi-parameter sockets.	Replace the faulty board with a new one.
CO_2 data on the screen is wrong.	The CO_2 sensor is faulty.	Replace the faulty sensor with a new one.
	The CO_2 adapter is faulty.	Replace the faulty adapter with a new one.
CO cannot be measured. (Injectate temperature Ti or blood temperature Tb cannot be measured or CO curve does not appear.)	The catheter, bath probe, inline sensor or connection cord is faulty.	Replace the faulty catheter, bath probe, inline sensor or connection cord with a new one.
	The MP2 board is faulty if the Ti or Tb cannot be measured at any multi-parameter sockets or the CO curve does not appear even when any multi-parameter socket is used.	Replace the faulty board with a new one.
	The MP3 board, MP2 board or motherboard is faulty if the Ti or Tb cannot be measured at the No. 3 multi-parameter socket only or the CO curve does not appear with the No. 3 socket.	Replace the MP3 board, MP2 board or ECG input block with a new one*.
	The MP1 board or MP2 board is faulty if the Ti or Tb cannot be measured at the No. 1 and No. 2 multi-parameter sockets or the CO curve does not appear with the No. 1 and No. 2 sockets.	Replace the faulty board with a new one.
CO data on the screen is wrong. (Ti or Tb temperature data on the screen is wrong.)	The catheter, bath probe or inline sensor is faulty.	Replace the faulty catheter, bath probe or inline sensor with a new one.
	The MP2 board is faulty if the Ti data is wrong but FiO_2 data can be measured at all the multi-parameter sockets or Tb data is wrong but thermistor method respiration can be measured at all the multi-parameter sockets.	Replace the faulty board with a new one.

* ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.

ECG/BP Output Problems

Problem	Possible Cause/Criteria	Action
The instrument does not output the ECG, HT (heart rate) or BP signal from the ECG/BP OUT socket.	The ECG/BP output cable is faulty.	Replace the ECG/BP output cable with a new one.
	The ECG and HT signals do not output without ECG measurement.	Measure the ECG.
	The BP signal is not output if the blood pressure is measured at the No. 2 or No. 3 multi-parameter sockets.	Measure the invasive blood pressure at the No. 1 multi-parameter socket.
	The connection cable between the DPU board and ECG RESP1 board is disconnected if the ECG, HT and BP are not output.	Check the connection.
	The DPU board or ECG RESP1 board is faulty if one of the three signals (ECG, HT and BP) is not output.	Replace the DPU board or ECG input block with a new one*.
The ECG or BP waveform from the ECG/BP OUT socket is wrong.	The DPU board is faulty if the ECG or BP waveform amplitude is wrong at the ECG/BP OUT socket but the ECG and invasive blood pressure waveforms are correctly displayed on the screen.	Replace the faulty board with a new one.

* ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.

Option Problems

Problem	Possible Cause/Criteria		Action
The instrument does not display the full disclosure window.	The optional QM-421P flash disk card is not installed.		Install the card into the slot on the MAIN board completely.
	The QM-421P installation, QM-421P card or MAIN board is faulty if “QM-421P” is not displayed at the “OPTION” on the DIAGNOSTIC CHECK screen.		Install the card into the slot on the MAIN board completely. Replace the faulty card or board with a new one if the problem still exists after the card installation.
	“SYSTEM INITIALIZE” is not done or the QM-421P card or MAIN board is faulty if “QM-421P” is displayed at the “OPTION” on the DIAGNOSTIC CHECK screen.		Touch the “SYSTEM INITIALIZE” key on the DIAGNOSTIC CHECK screen to perform the system initialization. Replace the faulty card or board with a new one if the problem still exists after the system initialization.
The instrument does not transmit the patient’s data at all.	The optional ZB-800P transmitter is not connected to the instrument.		Connect the ZB-800P to the instrument completely.
	The channel for the ZB-800P is not set at the central monitor or telemetry system.		Set the channel correctly at the central monitor or telemetry system.
	The ZB-800P or DPU board is faulty.		Replace the faulty transmitter or DPU board with a new one.
The instrument has no communication with the other bedside monitors and central monitors.	The optional QI-101P network card is not installed into the instrument.		Install the network card into the instrument completely.
	The network communicating symbol does not appear on the screen.	The network card is poorly inserted into the slot of the instrument.	Firmly insert the network card into the slot.
		The network cable such as 10Base-T cable is poorly connected between the network card and hub.	Firmly connect the network cable between the network card and hub.
		The hub connected to the instrument is not turned on or is faulty.	Turn on the hub. Replace the hub with a new one if the problem still exists after the power is turned on.
		The instrument is connected to the hub with 10Base-T cross wiring cable.	Use the correct internal wiring 10Base-T cable.
		The instrument is directly connected to the central monitor with 10Base-T straight wiring cable.	
		The network cable is faulty.	Replace the network cable with a new one.
		The network card or MAIN board is faulty.	Replace the faulty network card or MAIN board with a new one.

Section 3 Diagnostic Check

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Introduction

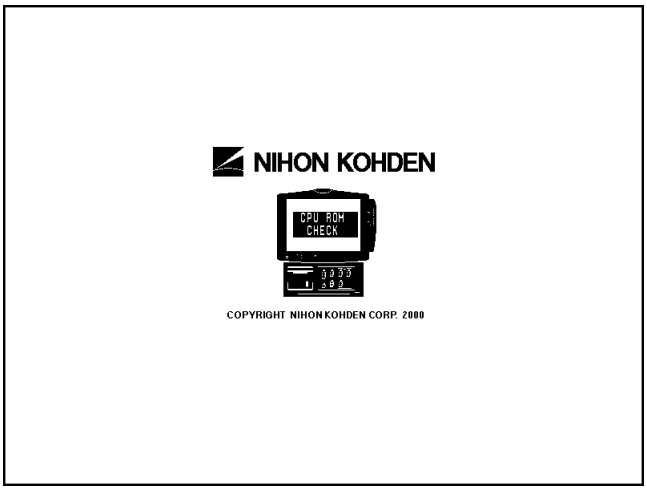
The instrument has two check programs which automatically or manually diagnose the instrument. The automatic check program (power on self check) is executed whenever the instrument is turned on. The manual check program can be executed at any time.

All errors detected during the power on self check, manual check, and any time in monitor mode are stored in an error history table that you can view.

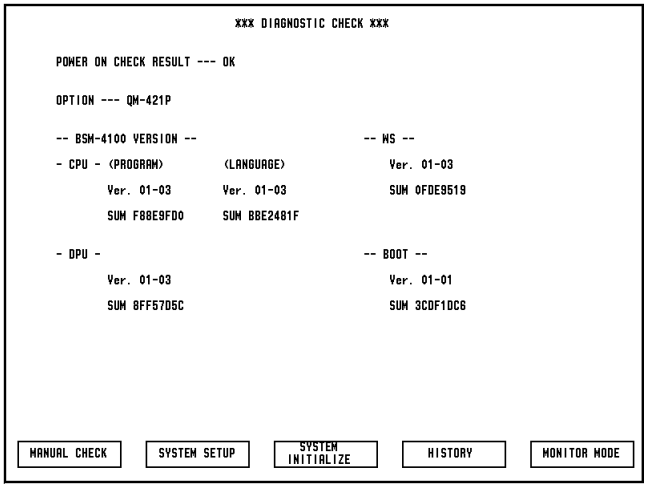
The manual check, error history, and system setup and initialization are accessed from the DIAGNOSTIC CHECK screen.

Power On Self Check

The following icon appears during the power on self check.



If no error is detected, the monitor mode begins and the patient monitoring display appears. If a serious error which does not allow the host CPU to execute the system program any more is detected, the screen changes to the following DIAGNOSTIC CHECK screen and the error mesage is displayed.



If a minor error such as “Backup data is damaged” or “Super capacitor is discharged” is detected, the monitor mode begins and the patient monitoring display appears after the power on self check. The detected error is stored in the error history table. Refer to “Calling Up the Error History” section.

The MAIN board and DPU board are checked as follows:

- CPU ROM CHECK: Checks the system ROM for the host CPU on the MAIN board. The MAIN board will be faulty if an error which causes a partial screen problem is found.
- CPU RAM CHECK: Checks the system RAM for the host CPU and patient data storage. The MAIN board will be faulty if an error which causes a screen problem is found.
- DPU ROM CHECK: Checks the system ROM for the CPU on the DPU board. The DPU board will be faulty if an error which causes a screen problem or data/ waveform display problem is found.
- DPU RAM CHECK: Checks the system RAM for the CPU on the DPU board. The DPU board will be faulty if an error which causes a screen problem or data/ waveform display problem is found.
- 2PORT RAM CHECK: Checks the common memory (Dual port RAM on the DPU board) for the communication between the MAIN and DPU boards. The DPU board will be faulty if an error which causes a screen problem or data/ waveform display problem is found.
- CLOCK IC CHECK: Checks the real-time clock IC on the MAIN board. If the date or time is wrong, the clock IC is initialized. The MAIN board will be faulty if an error is found.
- A/D CHECK: Checks the system counter. The MAIN board will be faulty if an error which disables the data processing function is found.
- E2PROM CHECK: Checks the backup memory for the system setup data storage. If the data is wrong, the memory is initialized. The MAIN board will be faulty if an error is found.

If a serious error is found in the abovementioned checks, the instrument displays the DIAGNOSTIC CHECK screen without displaying the patient monitoring screen.

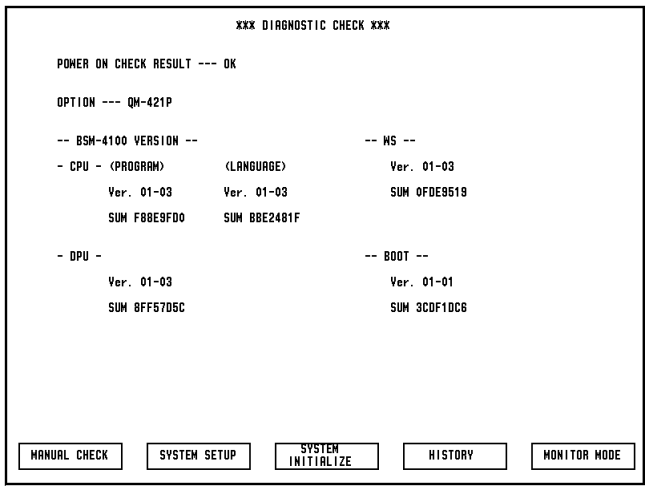
The following data checks are also done. The data is corrected if necessary.

- BACK UP CHECK: Checks the backed up data. If the backed up data has something wrong, the data is initialized.
- TIME CHECK: Checks correctness of the time.
- GET TIME CHECK: Checks the period during the AC power off in the battery operation and adjusts the time data if it is wrong.

Calling Up the DIAGNOSTIC CHECK Screen

Use this screen to view the error history or perform manual check or system setup and initialization.

1. With the power off, press the Power switch while pressing the SILENCE ALARMS key. Continue pressing the SILENCE ALARMS key until the DIAGNOSTIC CHECK screen appears.

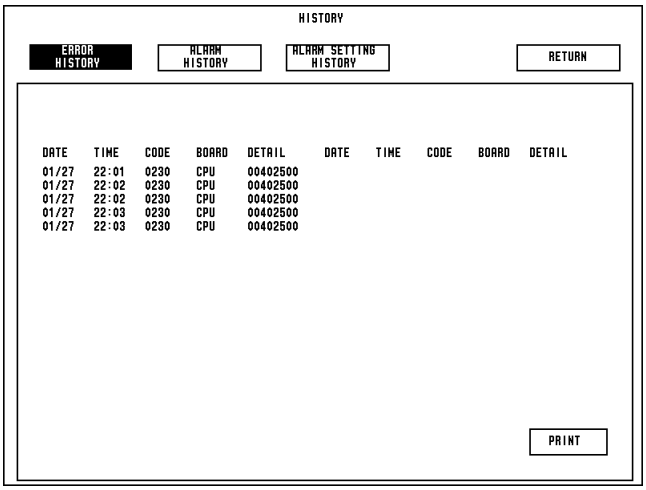


2. To exit the DIAGNOSTIC CHECK screen and return to the patient monitoring mode, touch the “MONITOR MODE” key.

Calling Up the Error History

The ERROR HISTORY screen shows the error history of the instrument. The error code, board name, time, and date the error occurred are listed on this screen. For an explanation of error codes, see the "Error Codes" section. The error history data is deleted whenever system initialization is performed.

1. From the DIAGNOSTIC CHECK screen, touch the "HISTORY" key. The HISTORY screen appears. Then, touch the "ERROR HISTORY" key to display the error history.



2. Touch the "PRINT" key to print the screen with the recorder.

3. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

Error Codes

When a fault is detected during operation or during the power on self check, the error is stored in the error history table. The error codes stored in the error history are only deleted when system initialization is performed. If the memory space for the error history is filled up, however, the oldest error code is deleted when a new error code is added.

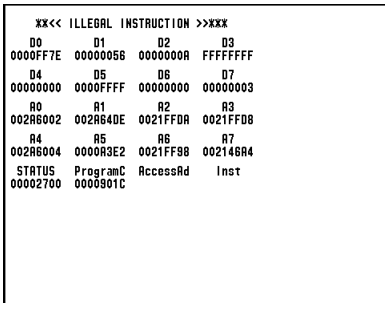
The message and description of each error code are described in the following table:

Error Code	Message	Description
0110	WATCH DOG	Interrupt from the watch dog timer
0210	BUS	Bus error occurred when an empty address was selected
0220	ADDRESS	Address error when a word accessed the odd address
0230	ILLEGAL	Illegal command is executed

0240	ZERO	Zero division error
0250	CHK	Check command error occurred during check
0260	TRAP	Trap command error
0270	PRIVILEGE	Privilege error
0280	SPURIOUS	Undefined interrupt error
0290	UNDEFINED	Not used
02A0	UNDEFINED	Not used
02B0	UNDEFINED	Not used
02C0	OTHER	Error from faults other than ones described above
0310	OS	Error detected by the OS
0410	CPU (ROM)	Error detected by CPU ROM check
0411	WS (ROM)	Error detected by WS ROM check
0420	CPU (RAM)	Error detected by CPU RAM check
0430	CPU (CMRAM)	Error detected by CPU communication RAM check
0440	A/D, D/A	Error detected by A/D and D/A check
0470	CLOCK	Error detected by the real time clock
0472	CLK DATA	Error detected by CLOCK DATA check
0480	E2PROM	Error detected by EEPROM check
0510	ATA CARD ACCESS ERROR	Error detected by ATA card (QM-421P) check
0400	OTHER	Error from faults other than those described above
A410	DPU (ROM)	Error detected by DPU ROM check
A420	DPU (RAM)	Error detected by DPU RAM check
A430	DPU (CMRAM)	Error detected by DPU communication RAM check

System Errors

A system error occurs when a fatal fault is detected during operation. All operation of the instrument is halted and the CPU operation status data at the system error appear on the left top of the screen. The system error is mostly stored in the error history table. In a few seconds after the status data is displayed, the instrument restarts. If the instrument repeats the restart, the MAIN board will be faulty.

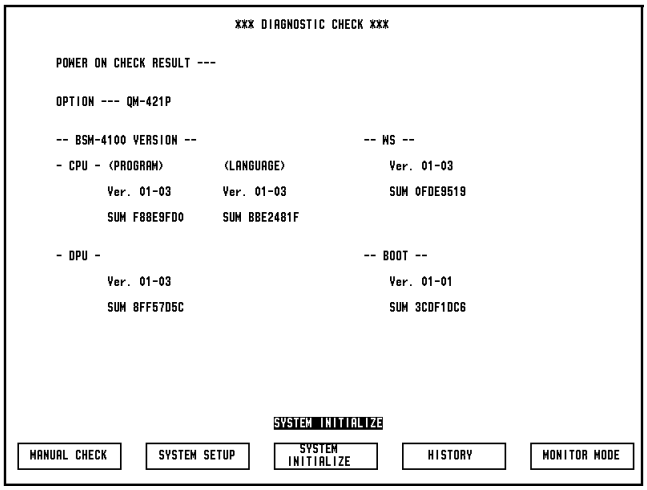


Initializing the System

You can delete all stored waveforms and data and the error history and return all settings to the factory defaults.

CAUTION

Initializing the system deletes all the patient data and error history, and returns the setting conditions to their default settings.

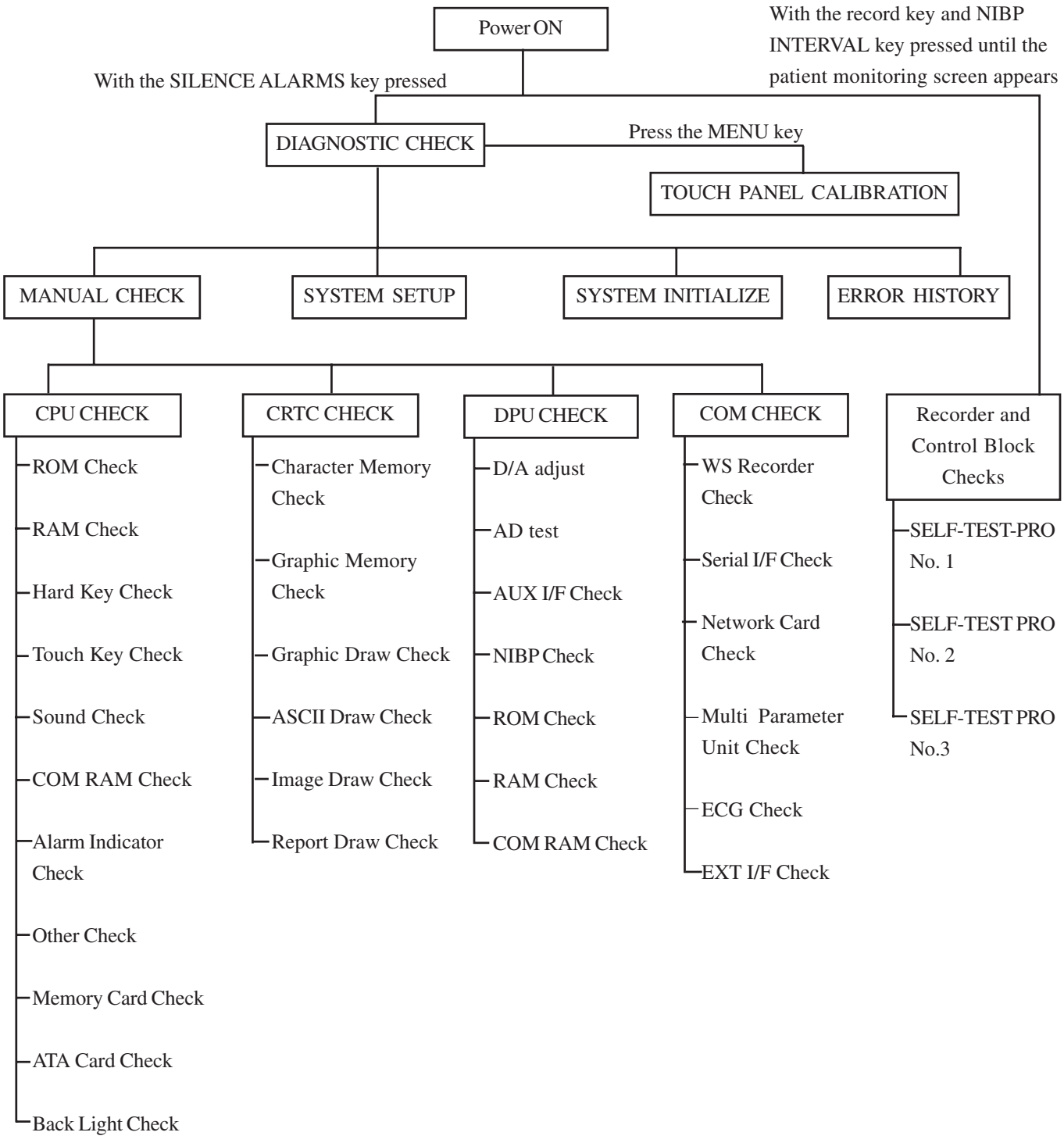


1. From the DIAGNOSTIC CHECK screen, touch the “SYSTEM INITIALIZE” key until a SYSTEM INITIALIZE confirmation message appears. (Approximately 3 seconds)
   All data and user settings are deleted.

2. To exit the DIAGNOSTIC CHECK screen and return to the patient monitoring mode, touch the “MONITOR MODE” key.

Performing Manual Check and Other Checks

The following checks are available.



In most of these checks, if a fatal error is detected during the check, the operating system hangs. When the system hangs, turn off the instrument and remove the cause.

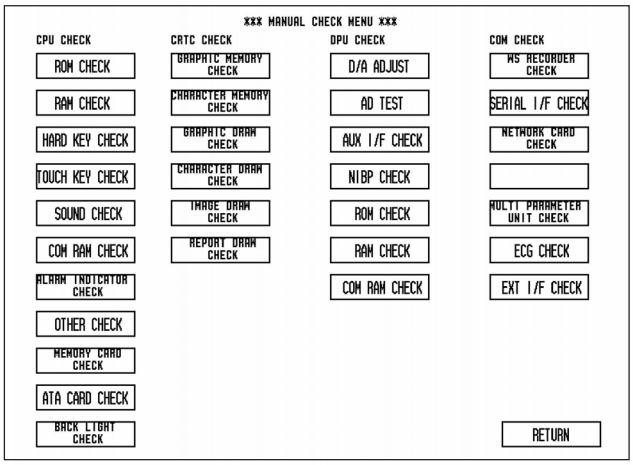
Calling Up the MANUAL CHECK MENU Screen

1. From the DIAGNOSTIC CHECK screen, touch the “MANUAL CHECK” key. The MANUAL CHECK MENU screen appears.

2. To test each item from the MANUAL CHECK MENU screen, touch a menu item key.

3. To return to the DIAGNOSTIC CHECK screen, touch the “RETURN” key.

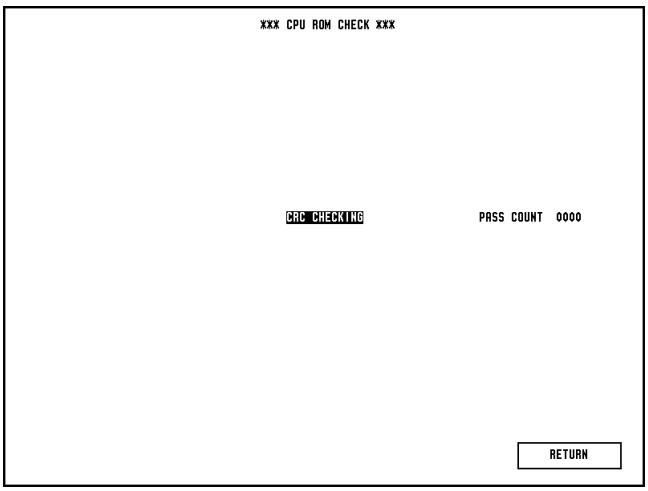
4. To exit the DIAGNOSTIC CHECK screen and return to the patient monitoring mode, touch the “MONITOR MODE” key.



CPU Check Menu Items

The CPU check menu items check the function of the CPU peripherals such as ROMs, RAMs, Switches, Touch Key, Sound generators, Alarm indicators and external memory modules.

ROM Check



This item checks the ROMs on the MAIN board by the CRC (cyclic redundancy check) technique. This check assigns a count number when one set of checks is successfully completed. A set of checks takes about 1 minute and 30 seconds.

If an error message appears, the MAIN board will be faulty.

Procedure to Start and Exit the ROM Check Program

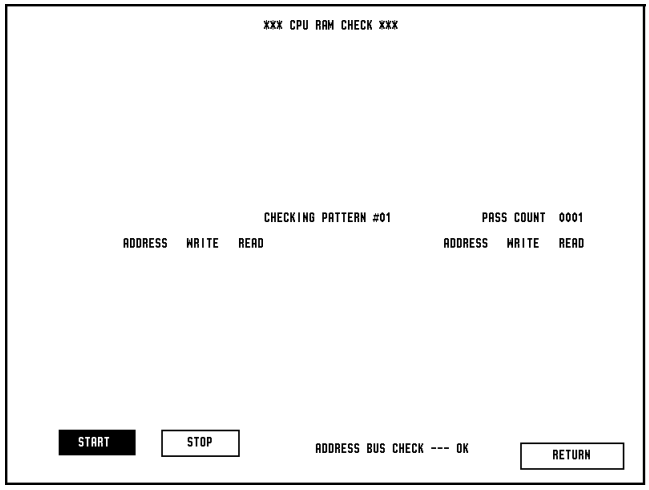
1. To select the ROM Check, touch the “ROM CHECK” key. The instrument automatically starts the ROM check.

2. The instrument repeats the check and increments the pass count until you touch the “RETURN” key.

3. If the check program finds an error, it displays the type of ROM (PROGRAM or IMAGE) in the above area.

4. To return to the MANUAL CHECK MENU screen at any time, touch the “RETURN” key.

RAM Check



This item checks the RAM on the MAIN board by comparing the test patterns it first wrote to the RAM with the test patterns it later read from the RAM. This test uses 15 test patterns and assigns a count number when a comparison of the 15 test patterns is successfully completed. The comparison of all the test patterns in this check takes about 4 minutes.

This check deletes the patient data. If an error message appears, the MAIN board will be faulty.

Procedure to Start, Stop, and Exit the RAM Check Program

1. To select the RAM Check, touch the “RAM CHECK” key. The instrument automatically starts the RAM check.

2. The instrument repeats the check and increments the pass count until the operator touches the “RETURN” key.

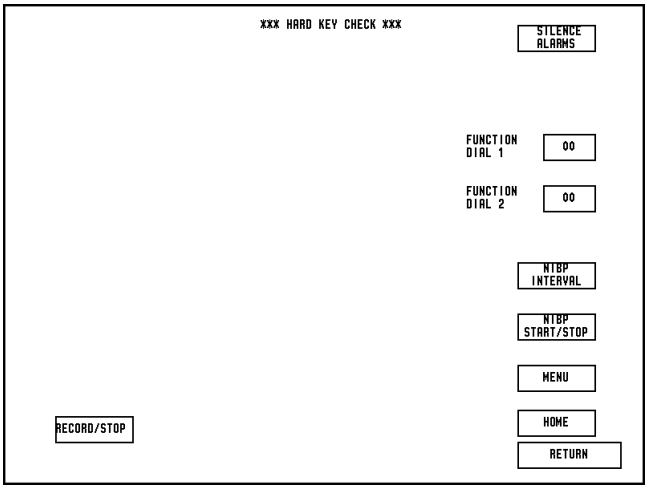
3. If the check program finds an error, it displays the address, write data and read data as shown in the above table.

4. To stop the check temporarily, touch the “STOP” key. The “START” key name changes to normal and the “STOP” key is highlighted.

   To continue the check, touch the “START” key again.

5. To return to the MANUAL CHECK MENU screen at any time, touch the “RETURN” key.

Hard Key Check



This item checks the operation of the hard keys on the front panel and the function dials. The hard key and dial layout appear. Pressing the hard key or rotating the function dial usually highlights the corresponding hard key or dial on the screen.

If the pressed hard key is not highlighted, the hard key may be faulty. If more than one hard key has this symptom, the operation board, function dial board or MAIN board will be faulty.

NOTE

The key does not give a key click sound when it is pressed in this check.

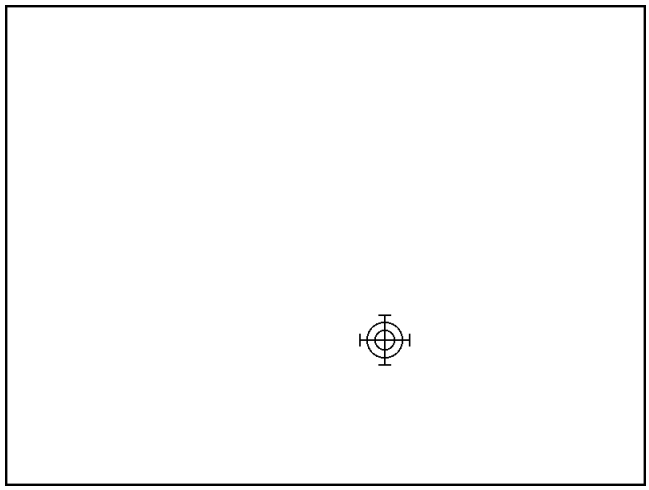
Procedure to Start the Check Keys or to Exit the Key Check Program

1. To check the hard keys, touch the “HARD KEY CHECK” key.

2. In the above screen, confirm that the corresponding pressed key is highlighted on the screen.

3. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

Touch Key Check



This item checks the touch key operation and positioning. When you start the check, the screen changes to the touch key check screen, and indicates the position where you touched. When you touch the screen and move your finger or touch pen, the target mark traces your position.

If the position of the target mark and the touched position do not match, calibrate the touch screen.

If you execute the touch key calibration and the position is still incorrect, the connection board, touch screen, or MAIN board will be faulty.

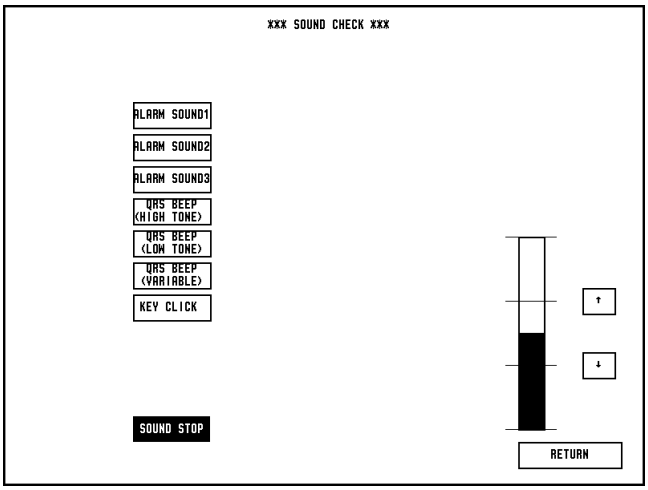
Procedure to Start the Touch Key Check or to Exit the Touch Key Check Program

1. To check the touch key, touch the “TOUCH KEY CHECK” key.

2. On the above screen, confirm that the touched position matches the target mark on the screen.

3. To return to the DIAGNOSTIC CHECK screen, press the HOME key.

Sound Check



This item checks the 7 types of sounds generated by the instrument. This check can also be used to check the alarm circuit and the QRS beep circuit. Check the quality of sound, loudness, noise, incorrect sound, etc.

If there is no sound or distorted sound, the speaker or MAIN board will be faulty.

Procedure to Check the Sound

1. To check the sound, touch the “SOUND CHECK” key.

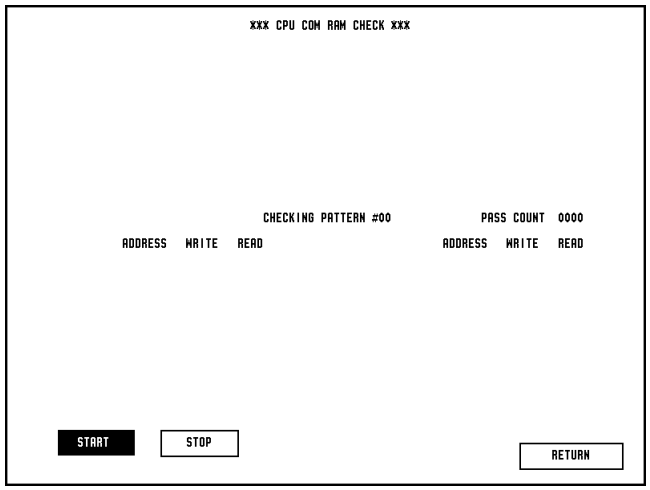
2. Touch a sound key, such as “ALARM SOUND1”, “ALARM SOUND2”, “ALARM SOUND3”, “QRS BEEP (HIGH TONE)”, “QRS BEEP (LOW TONE)”, “QRS BEEP (VARIABLE)”, “KEY CLICK” to start the check for that sound.

3. To stop the check, touch the “SOUND STOP” key.

4. To change the sound volume, touch the “↑” or “↓” key.

5. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

COM RAM Check



This item checks the dual port RAM for communication between the host CPU on the MAIN board and CPU on the DPU board. The check method is the same as the system RAM check. The check program indicates the address, write data and read data if an error is detected.

This RAM is located on the DPU board. Therefore if an error is detected, the DPU board or connector which connects the MAIN and DPU boards will be faulty.

Procedure to Start, Stop, and Exit the COM RAM Check Program

1. To select the COM RAM Check, touch the “COM RAM CHECK” key. The instrument automatically starts the RAM check.

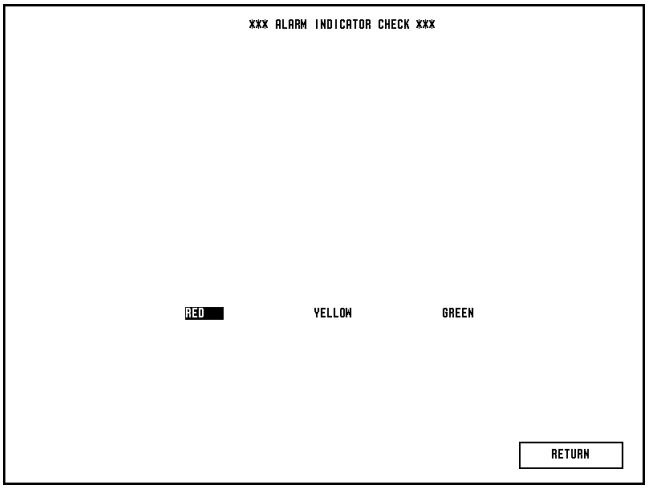
2. If the check program finds an error, it displays the address, write data and read data as shown in the above table.

3. To stop the check temporarily, touch the “STOP” key. The “START” key name changes to normal and the “STOP” key is highlighted.

   To continue the check, touch the “START” key again.

4. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

ALARM INDICATOR Check



This item checks the function of the alarm indicator located on the top of the instrument. Check the light of indicator lamp according to the screen indication.

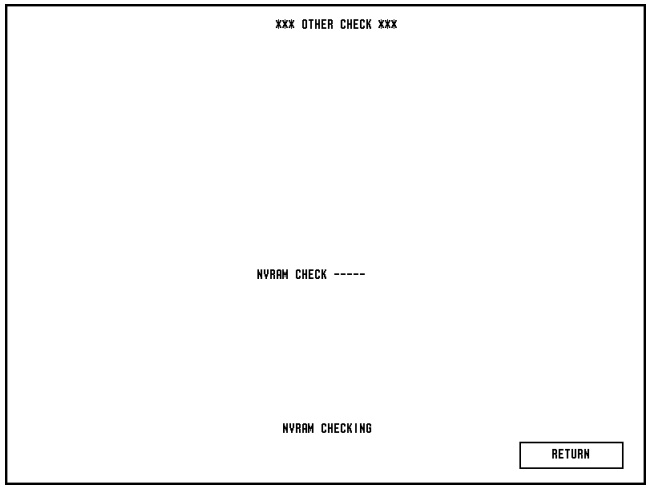
If the color does not light, the connection cable is loose or disconnected or the MAIN board or indicator board will be faulty. If the indicator lights partially, the indicator board is faulty.

Procedure to Start the ALARM INDICATOR Check Program

1. To select the Alarm Indicator Check, touch the “ALARM INDICATOR CHECK” key. The lighting color is highlighted on the screen sequentially.

2. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

OTHER Check



This item checks the clock IC and backup NVRAM (EEPROM). The NVRAM contains the system setup data. The check program checks correspondence between write and read data with the stored data retention. Therefore, this check does not damage the system setup data. If the clock IC and NVRAM have no error, the "OK" message appears on the screen and current date and time appear at the top of the screen. If an error message appears, the MAIN board will be faulty.

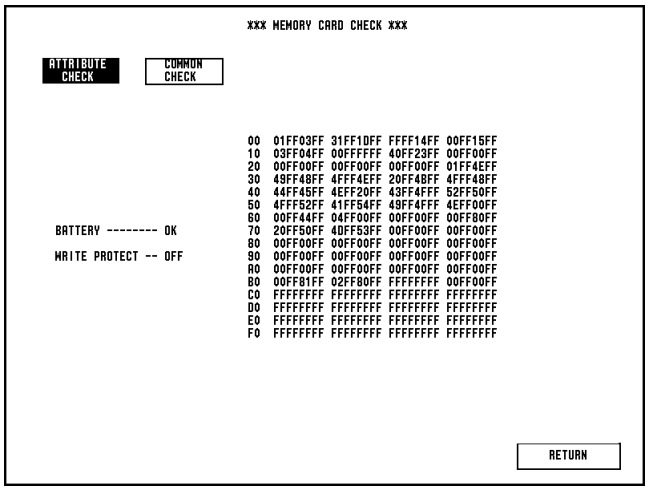
Procedure to Execute the OTHER Check Program

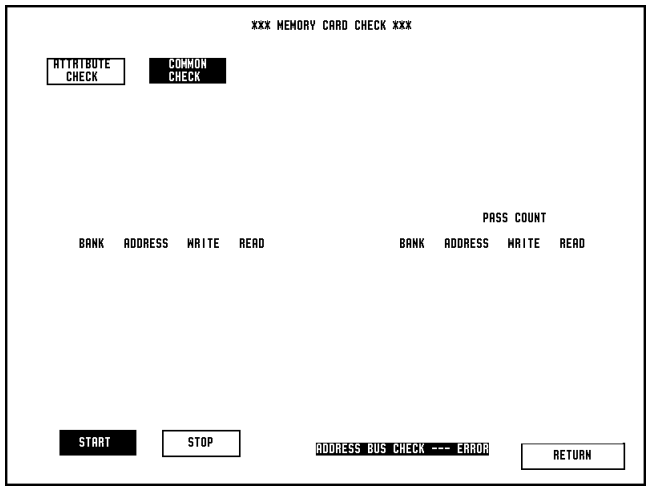
1. To select the OTHER Check, touch the "OTHER CHECK" key.

   The program starts the checking automatically and several minutes later, the program displays the result of checking.

2. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

MEMORY CARD Check


*** MEMORY CARD CHECK ***
ATTRIBUTE CHECK
COMMON CHECK
00 01FF03FF 31FF1DFF FFFF14FF 00FF15FF
10 03FF04FF 00FFFFFF 40FF23FF 00FF00FF
20 00FF00FF 00FF00FF 00FF00FF 01FF4EFF
30 49FF48FF 4FFF4EFF 20FF4BFF 4FFF48FF
40 44FF45FF 4EFF20FF 43FF4FFF 52FF50FF
50 4FFF52FF 41FF54FF 49FF4FFF 4EFF00FF
60 00FF44FF 04FF00FF 00FF00FF 00FF80FF
70 20FF50FF 4DFF53FF 00FF00FF 00FF00FF
80 00FF00FF 00FF00FF 00FF00FF 00FF00FF
90 00FF00FF 00FF00FF 00FF00FF 00FF00FF
A0 00FF00FF 00FF00FF 00FF00FF 00FF00FF
B0 00FF01FF 02FF80FF FFFFFFFF 00FF00FF
C0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF
D0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF
E0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF
F0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF
BATTERY -------- OK
WRITE PROTECT -- OFF
RETURN



This item checks the inserted PCMCIA card and its interface. There are two checks. The ATTRIBUTE CHECK displays the dump list of attribute area which is in the PCMCIA card. The COMMON CHECK is the write/read check for common area. This check continues until you touch the “STOP” key or “RETURN” key. The check method is the same as the system RAM check.

If the PCMCIA card is not inserted, the program displays the CARD NOT INSERTED message on the screen.

If an error is detected, the PCMCIA card or MAIN board will be faulty.

Procedure to Start MEMORY CARD Check Program

1. To select the MEMORY CARD Check, touch the “MEMORY CARD CHECK” key.

2. To display the dump list of attribute area which is in the memory card, touch the “ATTRIBUTE CHECK” key.

3. To start the common check, touch the “COMMON CHECK” key.

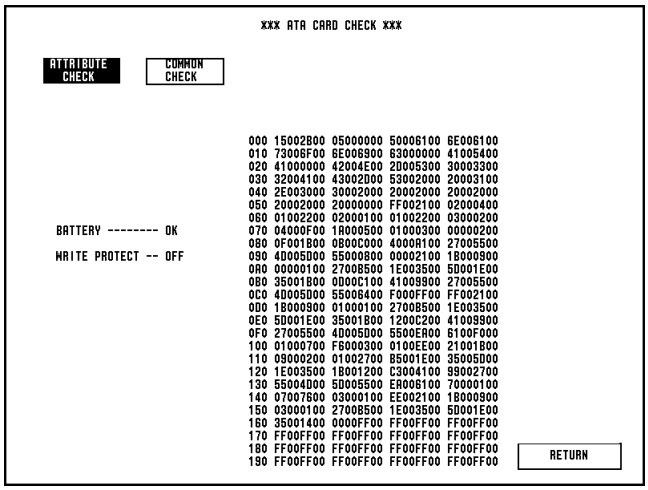
   If the check program finds an error, it displays the address, write data and read data as shown in the above table.

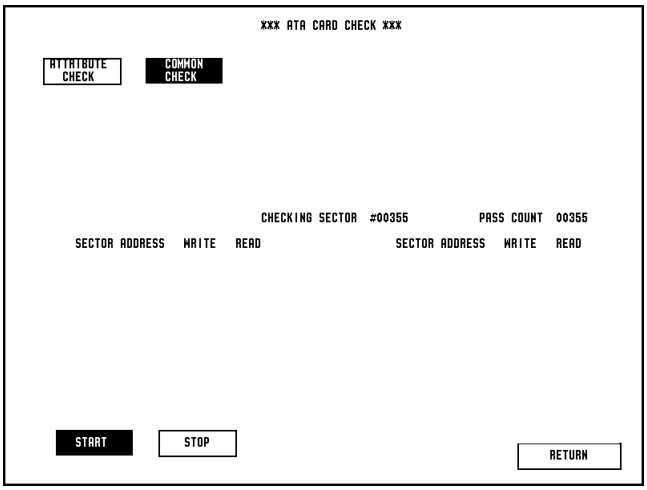
4. To stop the check temporarily, touch the “STOP” key. The “START” key name changes to normal and the “STOP” key is highlighted.

   To continue the check, touch the “START” key again.

5. To return to the MANAUL CHECK MENU screen, touch the “RETURN” key.

ATA CARD Check





This item checks the ATA card (QM-421P) and its interface. This check is almost the same as the MEMORY CARD check, except for the COMMON CHECK.

The COMMON CHECK is the write/read check for common area by each sector. This check continues until you touch the “STOP” key or “RETURN” key.

The check method is the same as the system RAM check.

If an error is detected, the QM-421P or MAIN board will be faulty.

Procedure to Start and Exit the ATA CARD Check Program

1. To select the ATA CARD Check, touch the “ATA CARD CHECK” key.

2. To display the dump list of attribute area which is in the ATA CARD, touch the “ATTRIBUTE CHECK” key and touch the “NEXT PAGE” or “PREVIOUS PAGE” keys, if necessary.

3. To start the common check, touch the “COMMON CHECK” key.

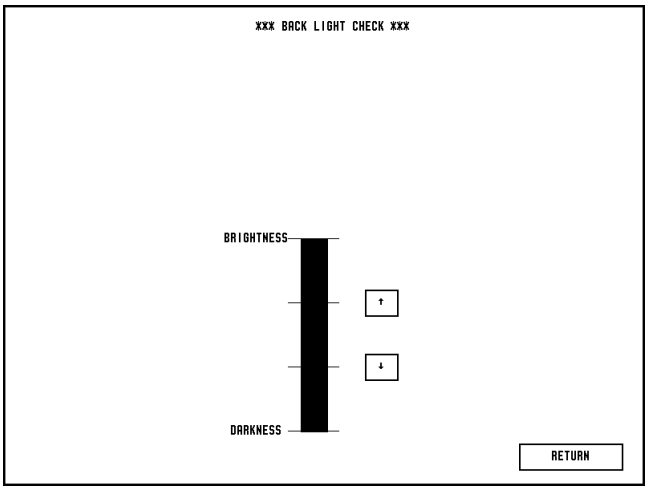
   If the check program finds an error, it displays the address, write data and read data as shown in the above table.

4. To stop the check temporarily, touch the “STOP” key. The “START” key name changes to normal and the “STOP” key is highlighted.

   To continue the check, touch the “START” key again.

5. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

Backlight Check



This item checks the brightness control of the LCD backlight. While the brightness is manually changed, check that it changes smoothly with no twinkling. Check that the backlight goes off and has no twinkling when the brightness is set to minimum.

If the brightness does not change smoothly or the light goes off in the middle of the brightness bar on the screen, it indicates the end of life of the backlight or faulty inverter board.

In that case, replace the inverter board, or fluorescent tube which is located on the top of the backlight unit.

Procedure to Check the Brightness of the LCD Backlight

1. To select the Backlight Check, touch the “BACK LIGHT CHECK” key.

   To control the brightness, touch the bargraph or the “↑” or “↓” key to increase or decrease the brightness.

2. To return to the MANUAL CHECK MENU screen at any time, touch the “RETURN” key.

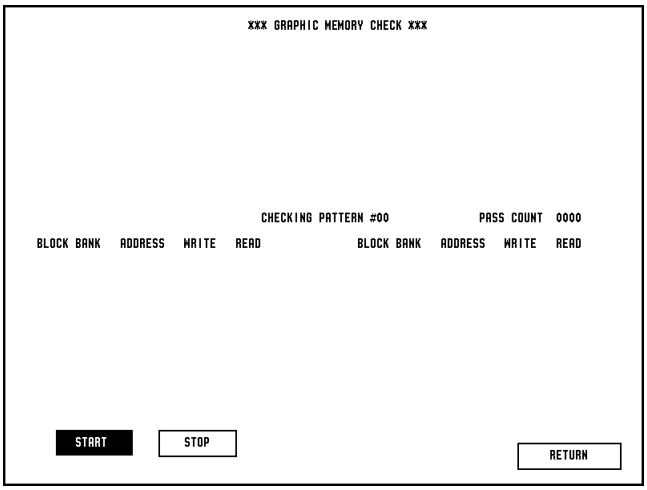
CRTC Check Menu Items

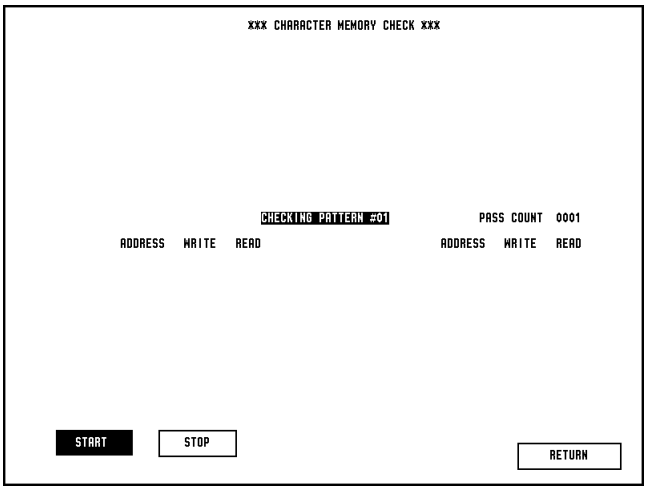
The CRTC check menu items check the function of the display control block, including the LCD unit. These check results cannot be recognized by the host CPU, so you must judge the result.

If an error is found, the MAIN board will be faulty.

GRAPHIC MEMORY Check and CHARACTER MEMORY Check

These items check the Graphic RAM and Character RAM on the MAIN board for the waveform display or character display by the write/read check technique. If an error is detected, the error bank, address and data are displayed as a table.





Procedure to Start the GRAPHIC MEMORY Check and CHARACTER MEMORY Check Program

1. To select the GRAPHIC MEMORY Check or CHARACTER MEMORY Check, touch the “GRAPHIC MEMORY CHECK” or “CHARACTER MEMORY CHECK” key.

   The “START” key is highlighted to indicate the process of checking.

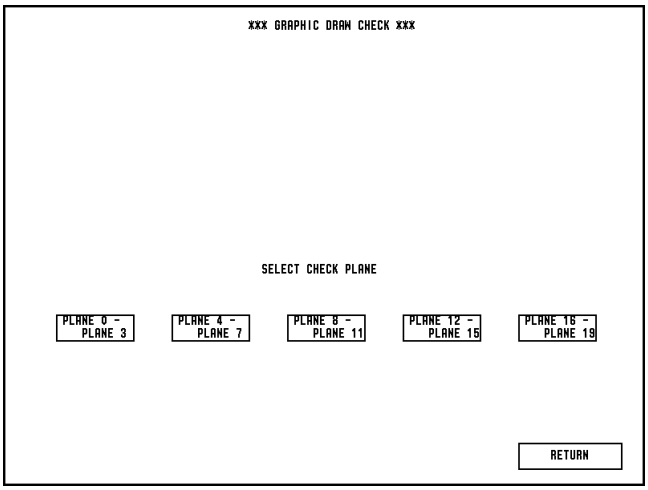
2. If the check program finds an error, it displays the address (and block bank), write data and read data as shown in the above table.

3. To stop the check temporarily, touch the “STOP” key. The “START” key name changes to normal and the “STOP” key is highlighted.

   To continue the check, touch the “START” key again.

4. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

GRAPHIC DRAW Check


xxx GRAPHIC DRAW CHECK xxx
SELECT CHECK PLANE
PLANE 0 - PLANE 3
PLANE 4 - PLANE 7
PLANE 8 - PLANE 11
PLANE 12 - PLANE 15
PLANE 16 - PLANE 19
RETURN

This item checks the function of the graphic draw plane. Check the figure of display and colors. At the same time, it checks for defects of LCD pixels all over the screen.

The plane for wave/graphic screen is in 20 screens and the check program displays 4 planes at a time.

If the screen has a wrong display, the MAIN board or LCD unit will be faulty.

Procedure to Execute the GRAPHIC DRAW Check Program

1. To select the Check, touch the “GRAPHIC DRAW CHECK” key.

   Touch the “PLANE 0 - PLANE 3” to “PLANE 16 - PLANE 19” key to display the plane combination.

2. When the program starts, it draws the grid line first. If you touch the screen, the pattern changes to the triangular waveform.

   After touching the screen again, the pattern on the screen is displayed all over the screen. The patterns are changed every time the screen is touched.

3. By rotating the upper function dial, the displaying plane(s) change, such as 0, 1, 2, 3 or ALL (the number depends on the plane combination).

   To select the waveform to be modified, rotate the lower function dial.

   The displayed color can be changed by pressing the SILENCE ALARMS key.

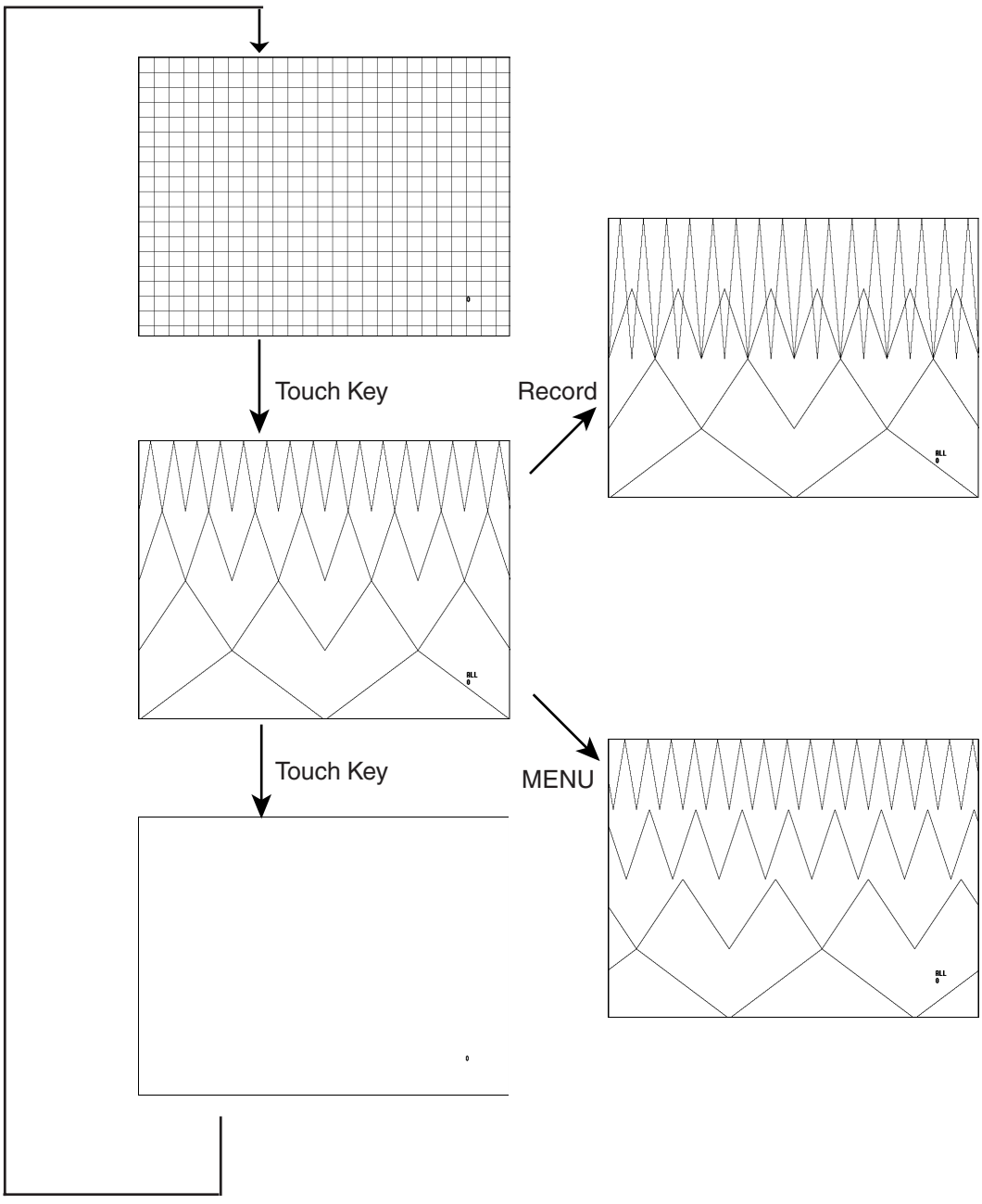
4. At the triangular waveform display mode, you can scroll the waveform by pressing the MENU key.

   Press the RECORD key to change the amplitude of each waveform.

5. To return to the GRAPHIC DRAW CHECK screen, press the HOME key.

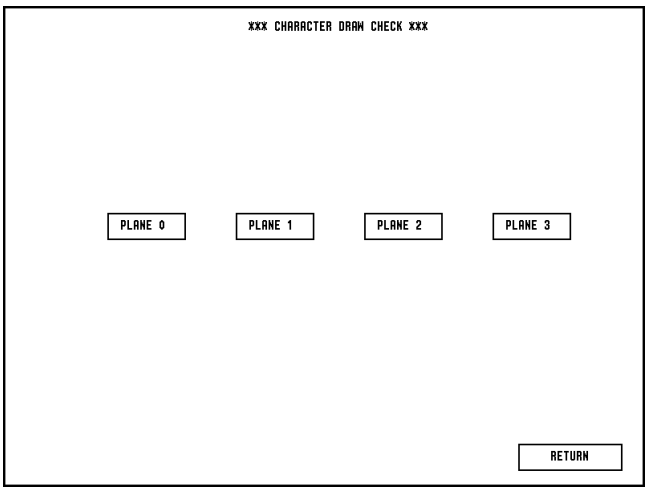
6. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

Screen Flow of GRAPHIC DRAW Check Program



For the TFT LCD screen, it is considered normal if some pixels have randomly abnormal color or do not light. (Up to 25 wrong pixels are considered normal at the maximum brightness.)

CHARACTER DRAW Check



This item checks the function of the character draw plane. Check the character display and colors. The plane for character screen is prepared in 4 screens and the check program displays one plane at a time.

Procedure to Execute the CHARACTER DRAW Check Program

1. To select the CHARACTER DRAW Check, touch the “CHARACTER DRAW CHECK” key and select a plane.

2. When the program starts, it draws the green characters on the black plane.

   Touch the “CHANGE BACK COLOR” key to reverse the plane color.

   If you press the MENU key, you can change the display mode in order of normal → blink → reverse → reverse/blink → normal.

3. By rotating the upper function dial, the displaying character size changes.

   The displayed color can be changed by pressing the SILENCE ALARMS key.

4. To return to the CHARACTER DRAW CHECK screen, press the HOME key.

5. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

If the screen has a wrong display, the MAIN board or LCD unit will be faulty.

Screen Flow of CHARACTER DRAW Check Program

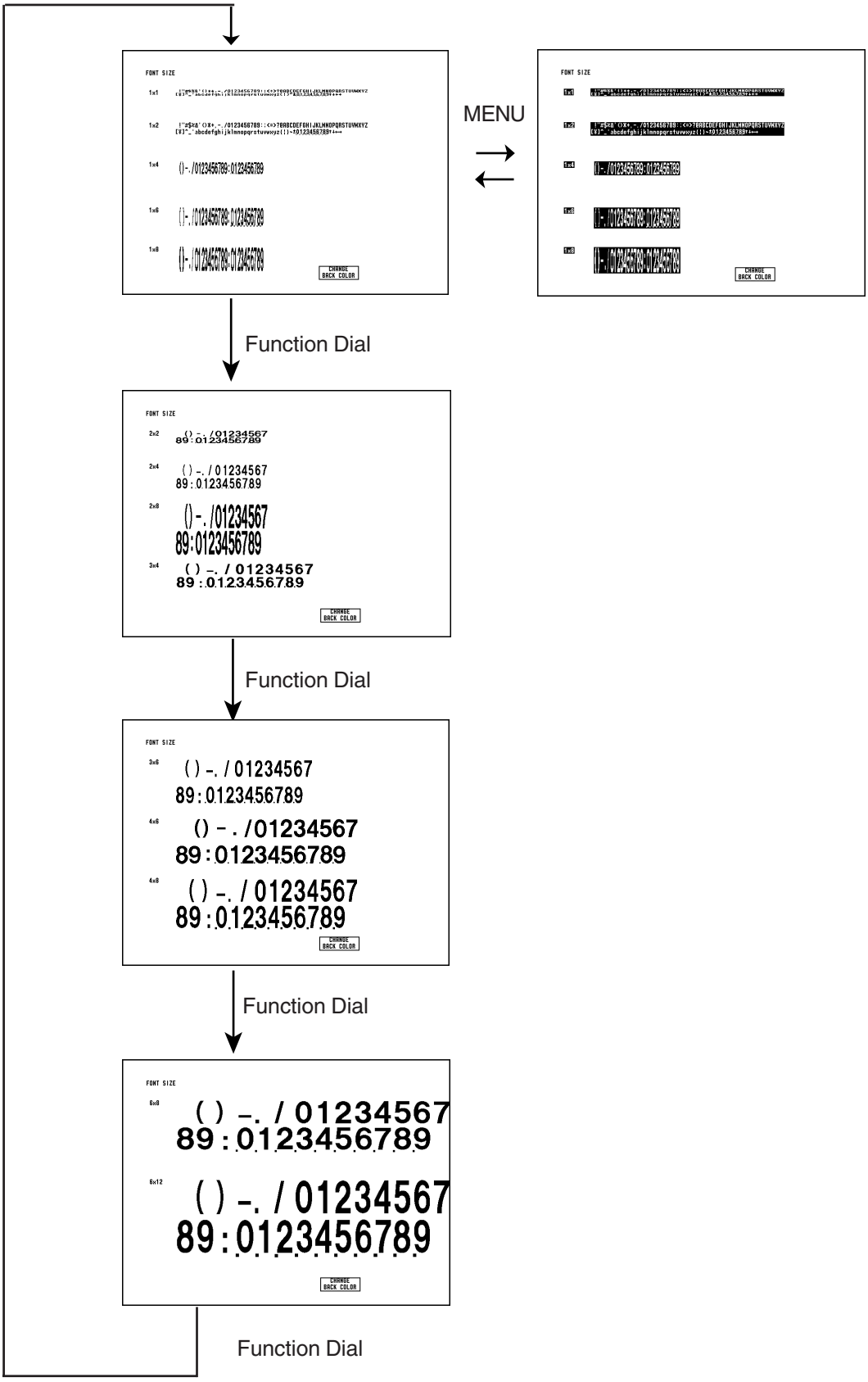
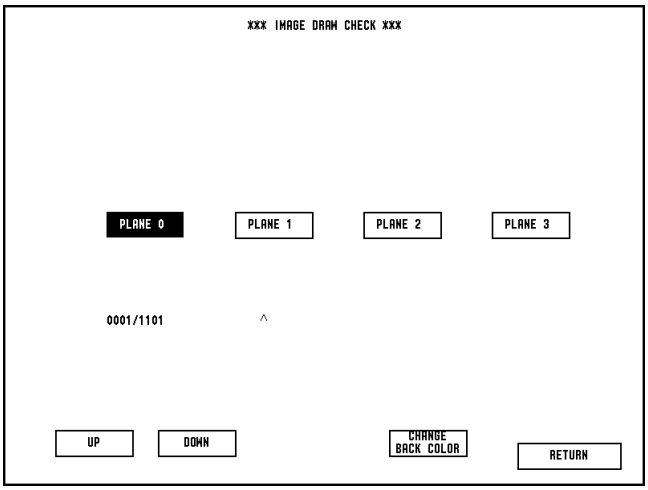


IMAGE DRAW Check



This item checks the function of the image draw. All the icons and messages, bitmap images, are displayed one by one. Check the image of the display and background colors.

This function helps multi-language capability.

Procedure to Start the IMAGE DRAW Check Program

1. To select the IMAGE DRAW Check, touch the “IMAGE DRAW CHECK” key. Touch the “CHANGE BACK COLOR” key to reverse the plane color.

2. When the program starts, it draws the white image on the black plane.

3. By rotating the lower function dial, the displaying image changes by ten.

   By rotating the upper dial, the image changes one by one. Using the “UP” or “DOWN” key on the screen also changes the image one by one.

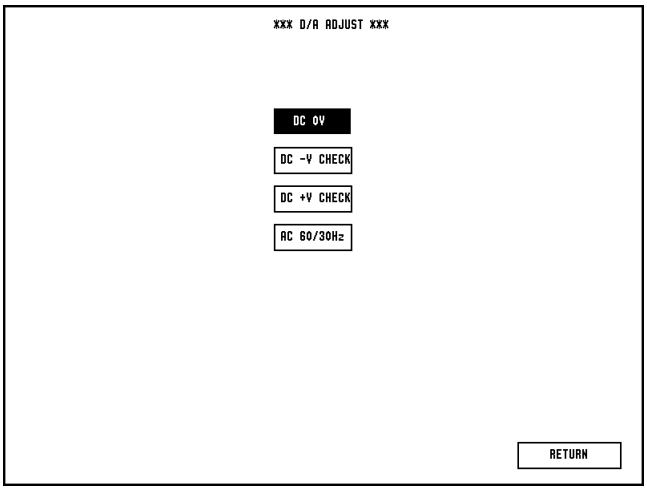
4. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

If the screen has a wrong display, the MAIN board or LCD unit will be faulty.

DPU Check Menu Items

The DPU board is a separate subsystem from the MAIN board. The DPU board consists of CPU, ROMs, RAMs, A to D converter and DMA.

D/A ADJUST



This item is used to check the output voltage level of the D/A converter.

Connect a digital multimeter or oscilloscope to the ZB-800P socket (Pin 4: Ground, Pin 5: Analog output) and check the following output signals.

	D to A output
DC 0 V	0 V ±10 mV
DC −V CHECK	−5.120 V ±1%
DC +V CHECK	+5.1175 V ±1%
AC 60/30 Hz	60 Hz ±5%, 6 Vp-p ±5%

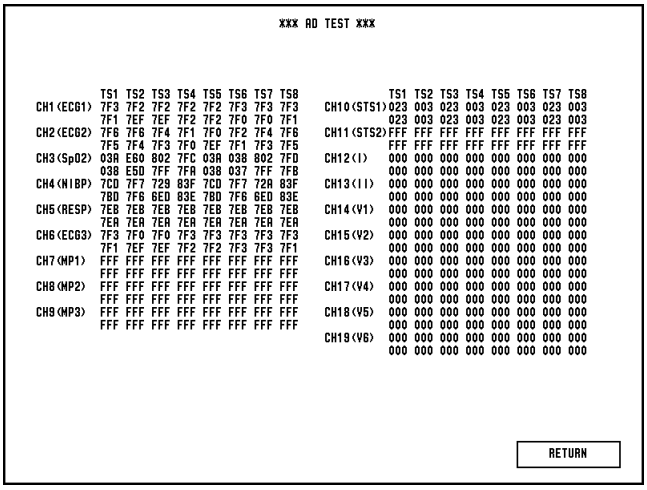
Procedure to Start the D/A Adjust Check

1. To select the D/A Adjust Check, touch the “D/A ADJUST” key at the DPU CHECK column. The program outputs 0 V DC.
   The “DC 0V” key is highlighted to indicate the status of output.

2. To change the output voltage or waveform, touch each name of the other keys.

3. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

AD TEST



This is not a check. The AD Test table shows the A to D converted values of all the analog parameters such as ECG, SpO_2 and NIBP. The other parameters are shown on the Multi Parameter Unit Check.

Each vital sign data are read from the A to D converter every 2 ms. The maximum and minimum data of each vital sign data are displayed every 512 ms.

ECG1: ECG waveform data for heart rate
ECG2: ECG waveform data for ZB-800P
SpO2: Plethysmographic pulse wave data
NIBP: NIBP measurement data
RESP: Respiration waveform data
ECG3: ECG waveform data for display
MP1: Multi-parameter 1 socket input data
MP2: Multi-parameter 2 socket input data
MP3: Multi-parameter 3 socket input data

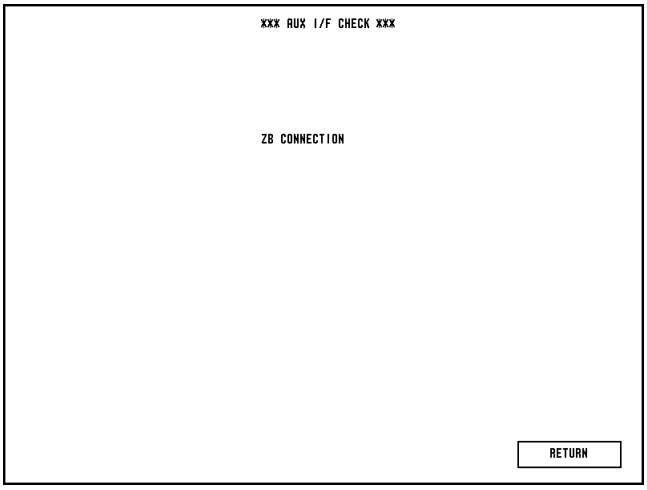
STS1: 12 lead ECG status 1 data from the CPU on the ECG RESP3 board
STS2: 12 lead ECG status 2 data from the CPU on the ECG RESP3 board
I: Lead I waveform data of 12 lead ECG
II: Lead II waveform data of 12 lead ECG
V1: Lead V1 waveform data of 12 lead ECG
V2: Lead V2 waveform data of 12 lead ECG
V3: Lead V3 waveform data of 12 lead ECG
V4: Lead V4 waveform data of 12 lead ECG
V5: Lead V5 waveform data of 12 lead ECG
V6: Lead V6 waveform data of 12 lead ECG

Procedure to start the AD Test

1. To select the AD Test, touch the “AD TEST” key at the DPU CHECK column. The program shows above table automatically.

2. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

AUX I/F Check



This check is used to check the waveform signal output when the ZB-800PG/K transmitter is connected to the instrument. The check program outputs a 15 Hz sawtooth waveform to the transmitter. The radio telemetry receiver, such as a cardiac telemetry system, receives the transmitted sawtooth waveform signal and displays it on the screen.

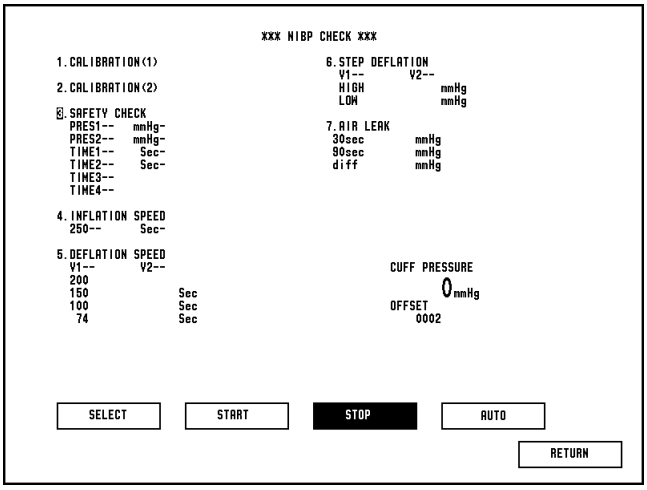
Procedure to start the AUX I/F Check

1. To select the AUX I/F Check, touch the “AUX I/F CHECK” key at the DPU CHECK column.
   The instrument communicates with the transmitter and if it recognized the connection with the transmitter, indicates “ZB CONNECTION” and outputs the sawtooth waveform to the transmitter.

2. If there is no connection with the transmitter, the instrument indicates “ZB NO CONNECTION”.

3. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

NIBP Check



This item checks the function and safety of NIBP circuit and pump. The NIBP check consist of the following check items:

1) Calibration (1)
2) Calibration (2)
3) Safety Check
4) Inflation Speed
5) Deflation Speed
6) Step Deflation
7) Air leak

To perform the test, prepare the following tools:

Hand bulb pump
Manometer
Y-shape hose connector (The Y-shape hose connector connects one tube of the dummy cuff to the handbulb pump and manometer.)
700 ml dummy cuff YS-558R9 (A 700 ml dummy cuff is a solid container that withstands high pressure. The inner volume of this container must be 700 ml.)
250 ml dummy cuff YS-564R2
Two 3.5 m air hoses (YN-901P and YN-921P)

Procedure to select the item and start the NIBP Check

1. To select the NIBP Check, touch the “NIBP CHECK” key at the DPU CHECK column. The program changes the screen to the NIBP CHECK.

2. Touch the “SELECT” key to select the check item number.

3. Touch the “START” key to start the check for the selected check item.

NOTE

Make sure there is no pressure applied on the cuff connector before pressing the “START” key. The program considers the pressure of the cuff connector as 0 mmHg at the start of the check.

4. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

1. Calibration (1)

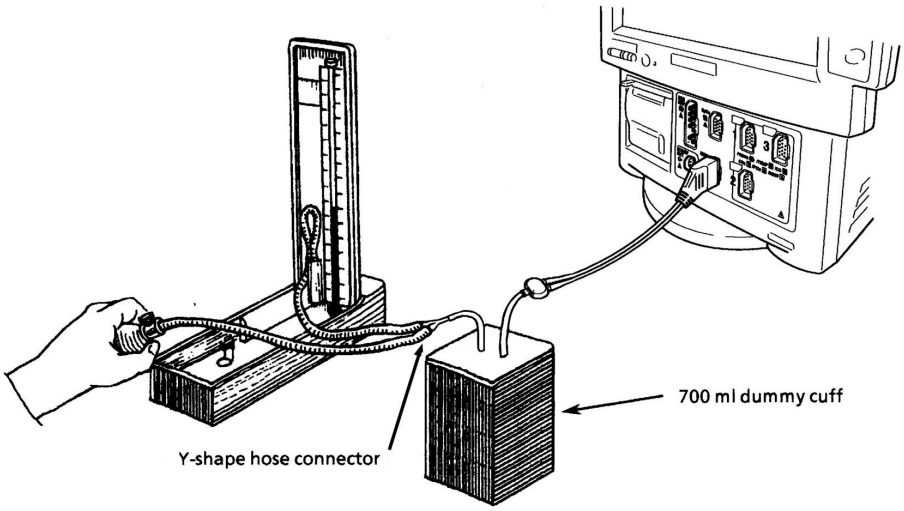
The Calibration (1) Check program is not used for calibration but is used to display the accuracy of the Pressure Sensor 1. The accuracy of the sensor changes with the measuring pressure. The following table shows the acceptable accuracy range of the Pressure Sensor 1 at different pressure ranges.

<Acceptable Accuracy Range of Pressure Sensor 1 at Different Pressure Ranges>

Pressure Range	Acceptable Accuracy Range
0 - 199 mmHg	+/–3 mmHg
200 - 300 mmHg	+/–4 mmHg

Checking the Accuracy of Pressure Sensor 1

1. Connect the manometer and hand bulb pump to the dummy cuff using the Y-shape connector and connect the dummy cuff to the instrument with the air hose as shown below.



2. Touch the “SELECT” key to select item number 1.

3. Touch the “START” key to start the check.

4. Immediately start pumping the hand bulb pump. Stop pumping the hand bulb pump when the pressure reading displayed on the NIBP Check display of the instrument is within one of the two pressure ranges. (0 - 199 or 200 - 300 mmHg).

5. Compare the pressure reading displayed on the NIBP Check display with the pressure reading on the manometer.

6. Repeat steps 4 and 5 for a reading in the other pressure range.

   If the accuracy of the pressure sensor for any of the two pressure ranges is out of the acceptable accuracy range, replace the NIBP Measure board or pneumatic circuit with a new one.

2. Calibration (2)

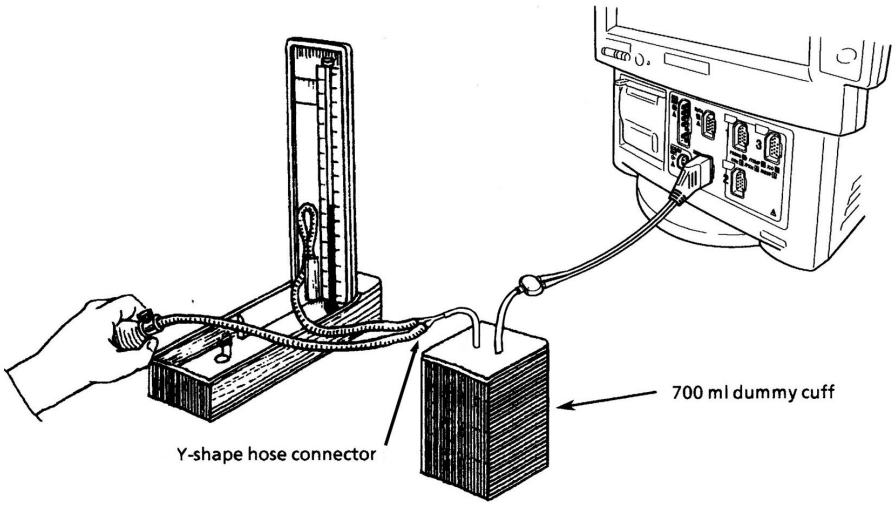
The Calibration (2) Check program is not used for calibration but is used to display the accuracy of the Pressure Sensor 2. The accuracy of the sensor changes with the measuring pressure. The following table shows the acceptable accuracy range of the Pressure Sensor 2 at different pressure ranges.

<Acceptable Accuracy Range of Pressure Sensor 2 at Different Pressure Ranges>

Pressure Range	Acceptable Accuracy Range
0 - 15 mmHg	–2 mmHg to +3 mmHg
16 - 200 mmHg	+/–8 mmHg
201 - 300 mmHg	+/–12 mmHg

Checking the Accuracy of Pressure Sensor 2

1. Connect the manometer and hand bulb pump to the dummy cuff using the Y-shape connector and connect the dummy cuff to the instrument with the air hose as shown below.



2. Touch the “SELECT” key to select item number 2.

3. Touch the “START” key to start the check.

4. Immediately start pumping the hand bulb pump. Stop pumping the hand bulb pump when the pressure reading displayed on the NIBP Check display of the instrument is within one of the three pressure ranges. (0 - 15, 16 - 200 or 201 - 300 mmHg).

5. Compare the pressure reading displayed on the NIBP Check display with the pressure reading on the manometer.

6. Repeat steps 4 and 5 for a reading in the other pressure range.

   If the accuracy of the pressure sensor for any of the three pressure ranges is out of the acceptable accuracy range, replace the NIBP Safety board or pneumatic circuit with a new one.

3. Safety Check

There are the following 6 check items monitored by the NIBP safety circuit.

<Description and Acceptable Range of Check item>

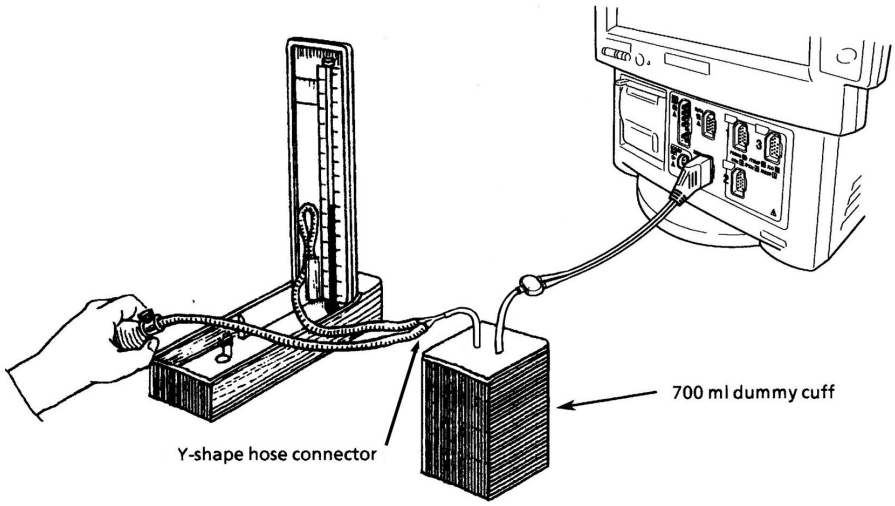
Check item	Description	Range
PRESS 1	Pressure limiter in the adult mode	315 +/– 15 mmHg
PRESS 2	Pressure limiter in the neonatal mode	157.5 +/– 7.5 mmHg
TIME 1	Time limiter in the adult mode	176 - 180 sec (>15 mmHg)
TIME 2	Time limiter in the neonatal mode	86 - 90 sec (>5 mmHg)
TIME 3	Interval error in the adult mode	>=10 sec (>15 mmHg)
TIME 4	Interval error in the neonatal mode	>=10 sec (>5 mmHg)

NOTE

Since the TIME 1 to TIME 4 checks require a pressure generator which supplies a pressure such as more than 5 mmHg or more than 15 mmHg during a certain period such as 3 or 1.5 minutes or supplies the pressure at a certain interval such as 10 seconds, do not perform these checks locally.

Connect the manometer and hand bulb pump to the dummy cuff using the Y-shape connector and connect the dummy cuff to the instrument with the air hose as shown below.

For the PRESS 1, use the YN-901P air hose.
For the PRESS 2, use the YN-921P air hose.



Checking the PRESS 1 Safety Check Item

1. Touch the “SELECT” key to select the item number 3.

2. Touch the “AUTO” key until the key name changes to “PRESS 1” so that the PRESS 1 Safety Check item is selected.

3. Touch the “START” key to start the check.

4. Start pumping the hand bulb pump as soon as the “CHECK” message appears.

5. Quickly increase the pressure until the manometer reads 300 mmHg. From the 300 mmHg pressure point, slowly increase the pressure further. Check that the “OK” message appears after the inflated pressure reaches a certain value in the 300 to 330 mmHg range. When the “OK” message appears, the “SAFETY CIRCUIT ON” message also appears in the cuff pressure window.

NOTE

- **If the pressure is raised too quickly to a value above 330 mmHg, the “ERROR” message appears.**
- **Slowly increasing the pressure after the 300 mmHg pressure point triggers the safety circuit to display the “OK” message within 30 seconds. If the pressure is maintained at 300 mmHg, the “OK” or “ERROR” message appears after 3 minutes because of triggering of a TIME1 safety event.**

If an “ERROR” message appears, replace the NIBP Safety board or pneumatic circuit with a new one.

Checking the PRESS 2 Safety Check Item

1. Touch the "SELECT" key to select item number 3.

2. Touch the "AUTO" key until the key name changes to "PRESS 2" so that the PRESS 2 Safety Check item is selected.

3. Touch the "START" key to start the check.

4. Start pumping the hand bulb pump as soon as the "CHECK" message appears.

5. Quickly increase the pressure until the manometer reads 150 mmHg. From the 150 mmHg pressure point, slowly increase the pressure further. Check that the "OK" message appears after the inflated pressure reaches a certain value in the 150 to 165 mmHg range. When the "OK" message appears, the "SAFETY CIRCUIT ON" message also appears in the cuff pressure window.

NOTE

- **If the pressure is raised too quickly to a value above 165 mmHg, the "ERROR" message appears.**
- **Slowly increasing the pressure after the 150 mmHg pressure point triggers the safety circuit to display the "OK" message within 30 seconds. If the pressure is maintained at 150 mmHg, the "OK" or "ERROR" message appears after 3 minutes because of triggering of a TIME1 safety event.**

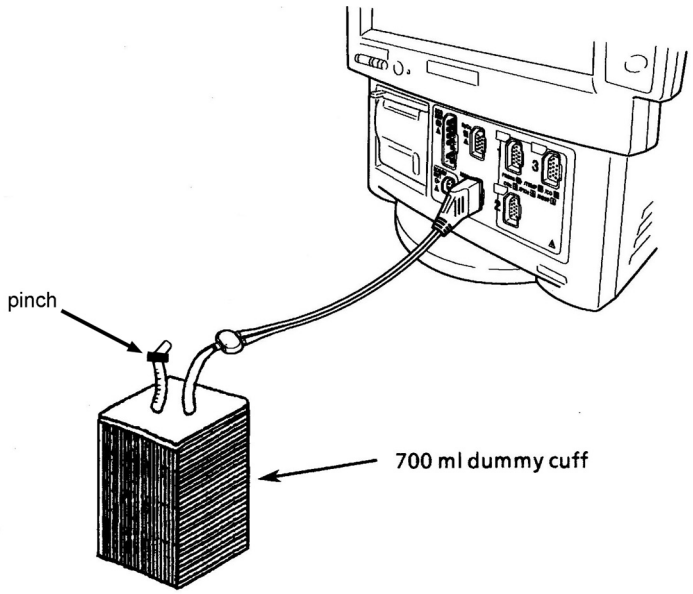
If an "ERROR" message appears, replace the NIBP Safety board or pneumatic circuit with a new one.

4. Inflation Speed

This is used to check the inflation speed of the pressure pump. The specifications state that the cuff pressure must be able to reach 250 mmHg in less than 7 seconds.

Checking the Inflation Speed

1. Connect the 700 ml dummy cuff to the instrument with the 3.5 m air hose as shown below.



2. Touch the “SELECT” key to select item number 4.

3. Touch the “START” key to start the check.

   If the inflation speed is less than 7 seconds, an “OK” message appears.

   If an “ERROR” message appears, replace the NIBP Safety board or pneumatic circuit with a new one.

5. Deflation Speed

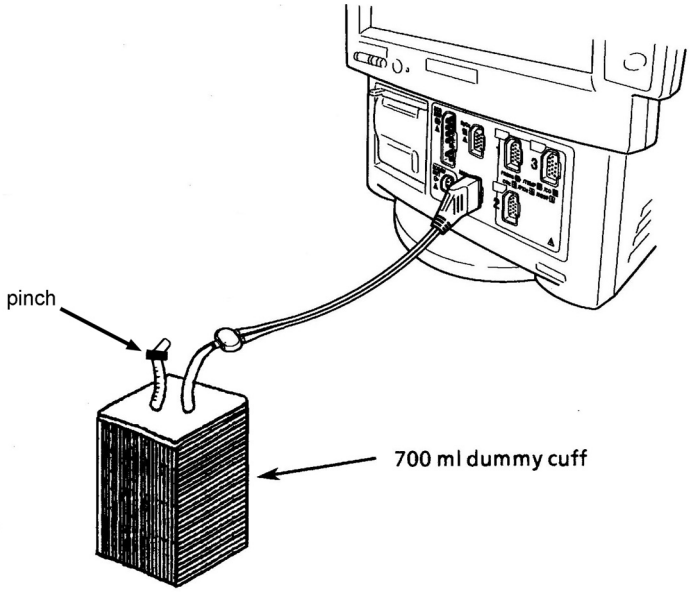
NOTE

Skip this deflation speed check because it is covered in the "6. Step Deflation" check.

This is used to check the deflation speed through the two solenoid valves (V1 and V2) at different stages of pressure drop. An "OK" message is displayed if it takes 1.4 to 3.0 seconds for V1 and 2.5 to 4.3 seconds for V2. If not, an "ERROR" message is displayed.

Checking the Deflation Speed

1. Connect the 700 ml dummy cuff to the instrument with the 3.5 m air hose as shown below.



2. Touch the "SELECT" key to select item number 5.

3. Touch the "START" key to start the check.

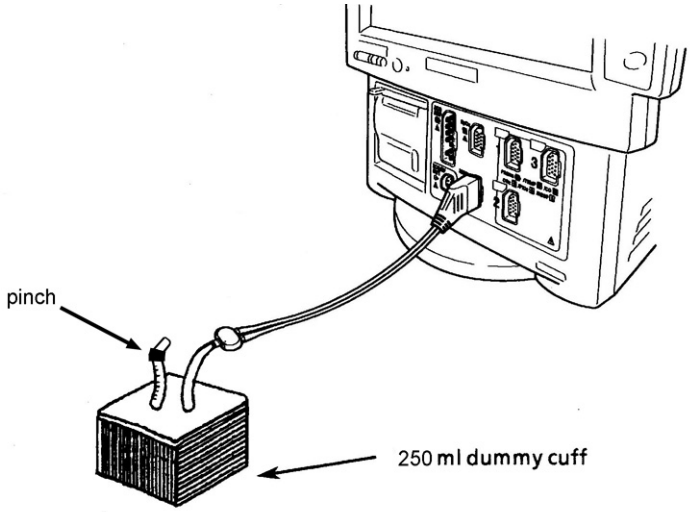
   If an "ERROR" message appears, replace the NIBP Safety board or pneumatic circuit with a new one.

6. Step Deflation

This checks the step deflation of the cuff at given pressure.
HIGH pressure: Valve 1 opens for 40 ms and Valve 2 opens for 70 ms at 250 mmHg.
The “OK” message appears if the pressure drop is 5 to 20 mmHg.
LOW pressure: Valve 1 opens for 60 ms and Valve 2 opens for 80 ms at 20 mmHg.
The “OK” message appears if the pressure drop is 1 to 10 mmHg.

Checking the Step Deflation

1. Connect the 250 ml dummy cuff to the instrument with the 3.5 m air hose as shown below.



2. Touch the “SELECT” key to select item number 6.

3. Touch the “START” key to start the check.

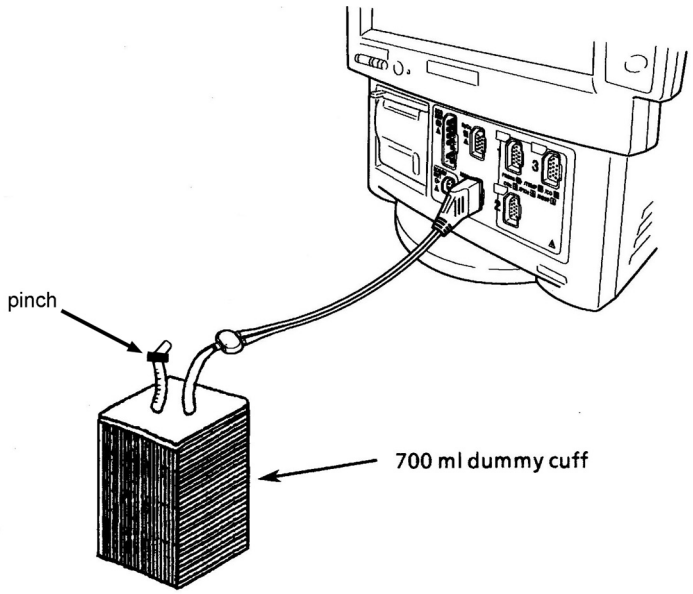
   If an “ERROR” message appears, replace the NIBP Safety board or pneumatic circuit with a new one.

7. Air Leak

This checks air leakage in the pneumatic circuit of NIBP module. In this check, the air pressure of the dummy cuff goes up to 300 mmHg. It then compares the pressure readings of the dummy cuff taken at 30 seconds and 90 seconds after the pressure of the dummy cuff had reached 300 mmHg. If the pressure readings differ by 5 mmHg or less, an "OK" message appears. If not, an "ERROR" message appears. In this case, make sure that the cuff connector and internal air tubes are firmly attached. If the "ERROR" message still appears, replace the NIBP Safety board or pneumatic circuit with a new one.

Checking the Air Leak

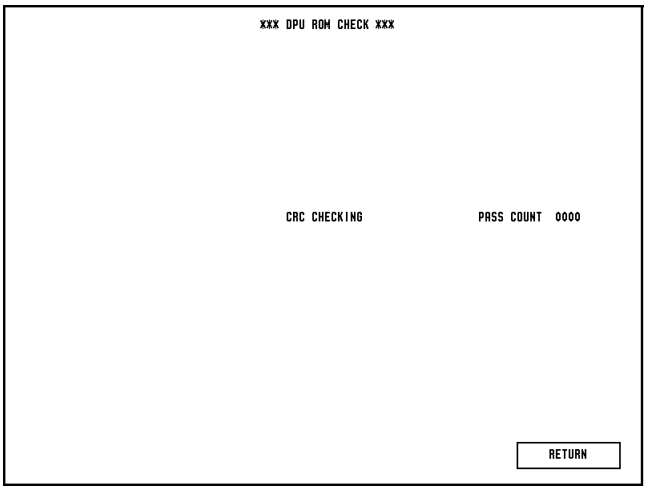
1. Connect the 700 ml dummy cuff to the instrument with the 3.5 m air hose as shown below.



2. Touch the "SELECT" key to select item number 7.

3. Touch the "START" key to start the check.

DPU ROM Check



This item checks the ROMs on the DPU board by the CRC (cyclic redundancy check) technique. This check assigns a count number when one set of checks is successfully completed.

If an error message appears, the DPU board will be faulty.

Procedure to Start and Exit the DPU ROM Check Program

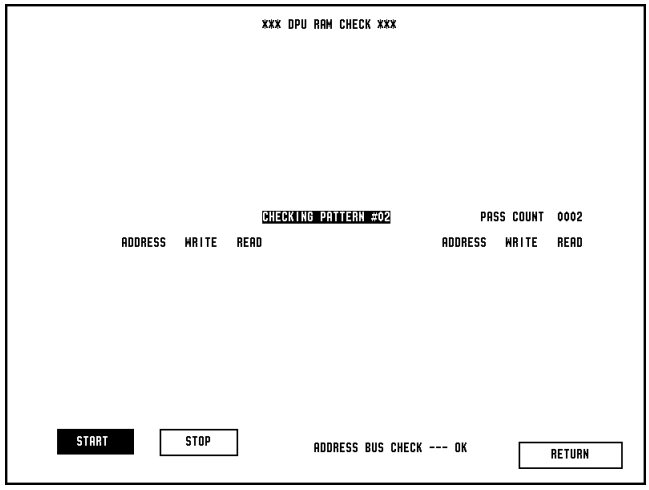
1. To select the DPU ROM Check, touch the “ROM CHECK” key at the DPU CHECK column.

2. The instrument repeats the check and increments the pass count until you touch the “RETURN” key.

3. If the check program finds an error, it displays the “ERROR” message on the screen.

4. To return to the MANUAL CHECK MENU screen at any time, touch the “RETURN” key.

DPU RAM Check



This item checks the RAM on the DPU board by comparing the test patterns (first written to the RAM) with the test patterns (later read from the RAM).

If an error message appears, the DPU board will be faulty.

Procedure to Start, Stop, and Exit the DPU RAM Check Program

1. To select the DPU RAM Check, touch the “RAM CHECK” key at the DPU CHECK column. The check program automatically starts.
   The “START” key is highlighted to indicate the process of checking.

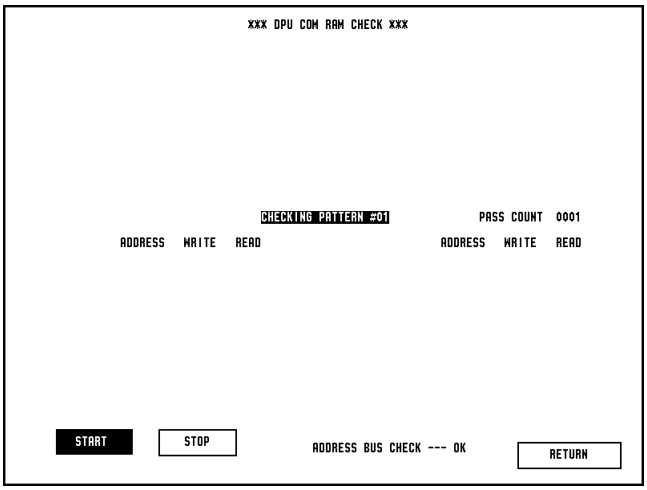
2. If the check program finds an error, it displays the address, write data and read data as above table.

3. To stop the check temporarily, touch the “STOP” key. The highlighted “START” key changes to normal and the “STOP” key is highlighted.

   To continue the check, touch the “START” key again.

4. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

DPU COM RAM Check



This item checks the dual port RAM for communication between the host CPU on the MAIN board and CPU on the DPU board. The check method is the same as the system RAM check. The check program indicates the address, write data and read data if an error is detected.

This RAM is located on the DPU board. Therefore if the error is detected, the DPU board will be faulty.

Procedure to Start, Stop, and Exit the DPU COM RAM Check Program

1. To select COM RAM Check, touch the “COM RAM CHECK” key at the DPU CHECK column. The check program automatically starts.
   The “START” key is highlighted to indicate that checking is being done.

2. If the check program finds an error, it displays the DPU part, address, write data and read data as shown in the above table.

3. To stop the check temporarily, touch the “STOP” key. The highlighted “START” key changes to normal and the “STOP” key is highlighted.

   To continue the check, touch the “START” key again.

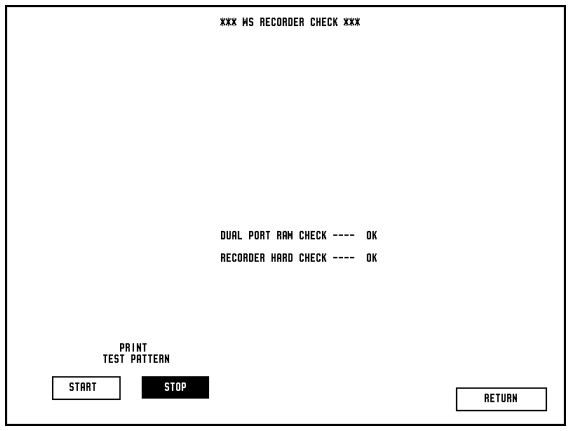
4. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

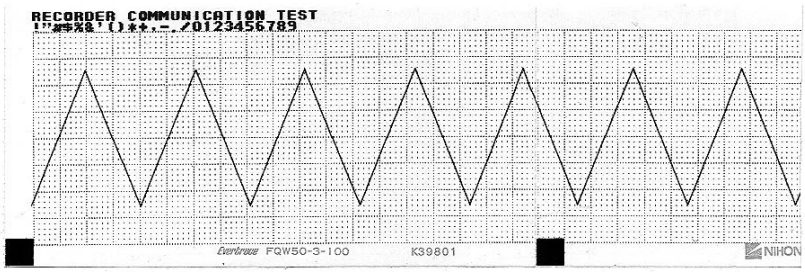
COM Check Menu Items

The COM check menu items check the communication with peripheral units such as recorder and external equipment.

WS RECORDER Check

This item checks the dual port RAM in the ASIC (RACOON) and the other recorder control block with the communication between the host CPU and local CPU on the MAIN board. The built-in recorder is one of the peripheral units for the host CPU. Physically, both the recorder control block and host CPU are on the MAIN board.





Procedure to Start the WS RECORDER Check Program

1. To select the WS RECORDER Check, touch the “WS RECORDER CHECK” key in the COM CHECK column.

   The program checks the function of the dual port memory which communicates with the host CPU and local CPU of the recorder control block and checks the other functions of the recorder control block.

2. Touch the PRINT TEST PATTERN “START” key. The host CPU communicates with the local CPU so that the above test pattern is recorded on the paper.

   The “START” key is highlighted to indicate the process of checking.

   Until you touch the “STOP” key, paper runs continuously.

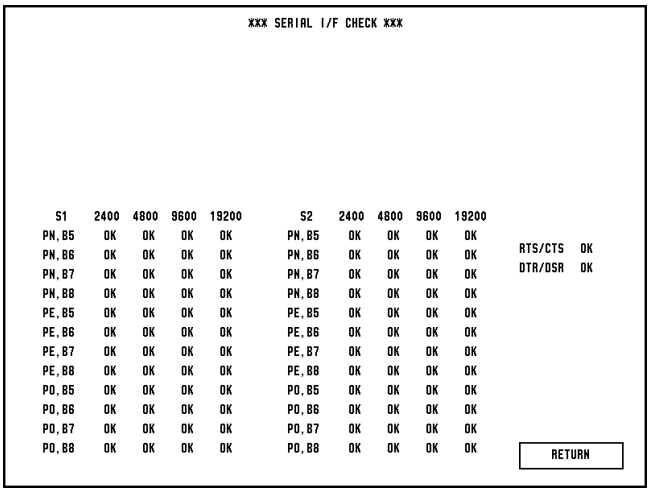
3. If the magazine is open or there is no paper, these status are displayed on the screen.

   If the status is not displayed in such condition, the MAIN board or recorder unit will be faulty.

SERIAL I/F Check

This item checks the communication interface for external equipment such as a personal computer.

To perform this check without a personal computer, you must make the following short circuits at the AUX socket.
Pins 2 and 27
Pins 3 and 28
Pins 4 and 29


*** SERIAL I/F CHECK ***
S1 2400 4800 9600 19200
PN,B5 OK OK OK OK
PN,B6 OK OK OK OK
PN,B7 OK OK OK OK
PN,B8 OK OK OK OK
PE,B5 OK OK OK OK
PE,B6 OK OK OK OK
PE,B7 OK OK OK OK
PE,B8 OK OK OK OK
PO,B5 OK OK OK OK
PO,B6 OK OK OK OK
PO,B7 OK OK OK OK
PO,B8 OK OK OK OK
S2 2400 4800 9600 19200
PN,B5 OK OK OK OK
PN,B6 OK OK OK OK
PN,B7 OK OK OK OK
PN,B8 OK OK OK OK
PE,B5 OK OK OK OK
PE,B6 OK OK OK OK
PE,B7 OK OK OK OK
PE,B8 OK OK OK OK
PO,B5 OK OK OK OK
PO,B6 OK OK OK OK
PO,B7 OK OK OK OK
PO,B8 OK OK OK OK
RTS/CTS OK
DTR/DSR OK
RETURN

Procedure to Start the SERIAL I/F Check Program

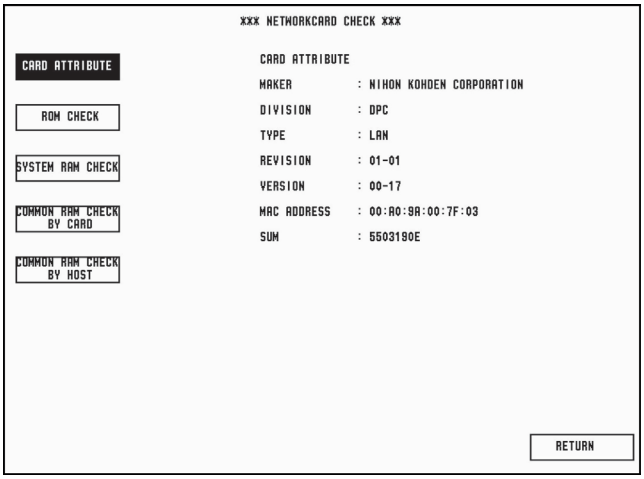
To select the SERIAL I/F Check, touch the “SERIAL I/F CHECK” key at the COM CHECK column. The check program automatically starts.

The check program changes the baud rate, data bit length and parity check condition to check the serial communication interface.

If an error message appears, the MAIN board will be faulty.

NETWORK CARD Check

This item checks the function of the QI-101P network card and its interface. To perform this check, the optional QI-101P network card is required.



Procedure to Start the NETWORK CARD Check Program

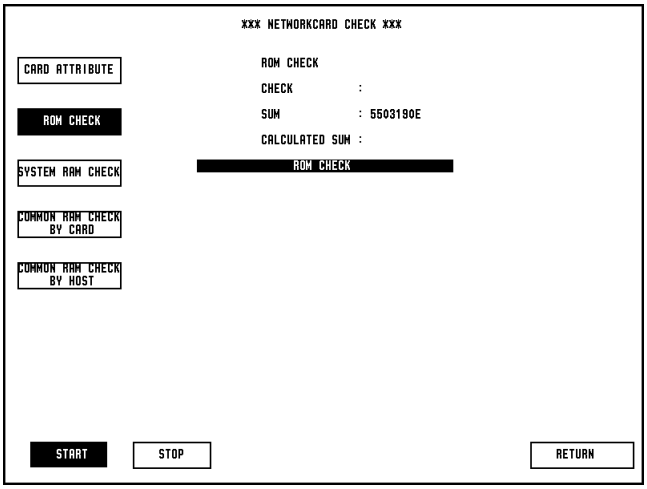
1. To select the NETWORK CARD Check, touch the "NETWORK CARD CHECK" key at the COM CHECK column.

   The check program recognizes the type of card and displays the attribute data which is memorized in the card.

   If the QI-101P network card is not inserted, the "INSERT NETWORK CARD" message appears on the screen instead of the above screen example. At that time, when you insert the network card, a few seconds later, the above screen appears automatically.

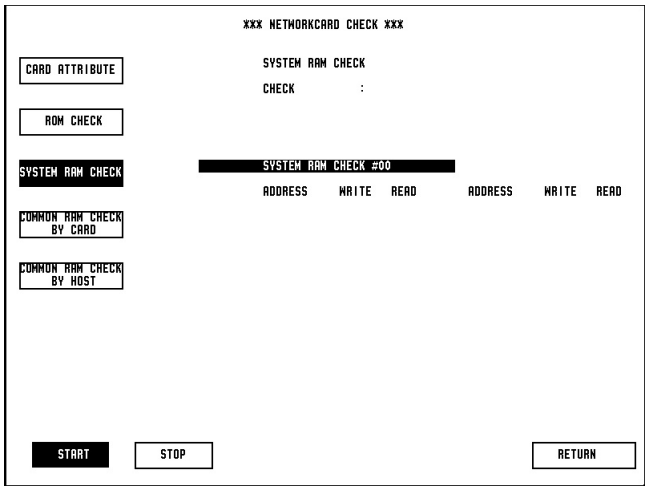
   If the check program can read the attribute data at the CARD ATTRIBUTE correctly and there is no error at the attribute data at COMMON RAM CHECK BY HOST but the instrument has no communication with the network, the network cable or hub will be faulty. If an error message appears at one of the five checks, the network card or MAIN board will be faulty.

2. Touch the "ROM CHECK" key on the screen. The CPU of the network card checks the program data of the ROM in the CPU using the check sum method and displays the check result on the following screen.

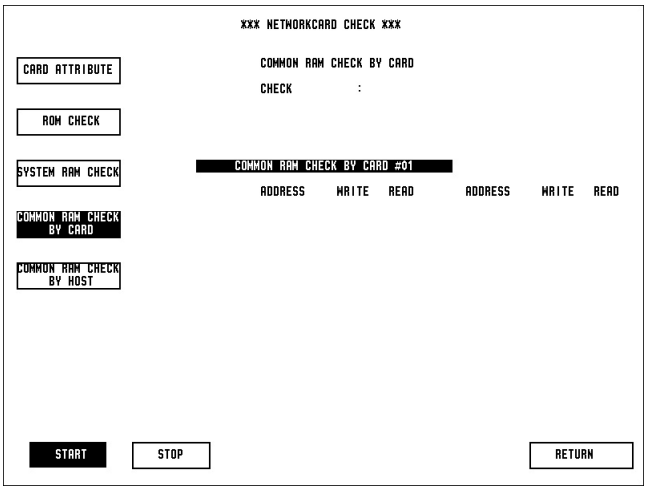


- CHECK: Displays the check result, i.e. “OK” or “ERROR”. When the CALCULATED SUM data is same as the SUM data, “OK” appears.
- SUM: The sum data of the program data stored in the ROM
- CALCULATED SUM: The sum data calculated from the program data in the ROM

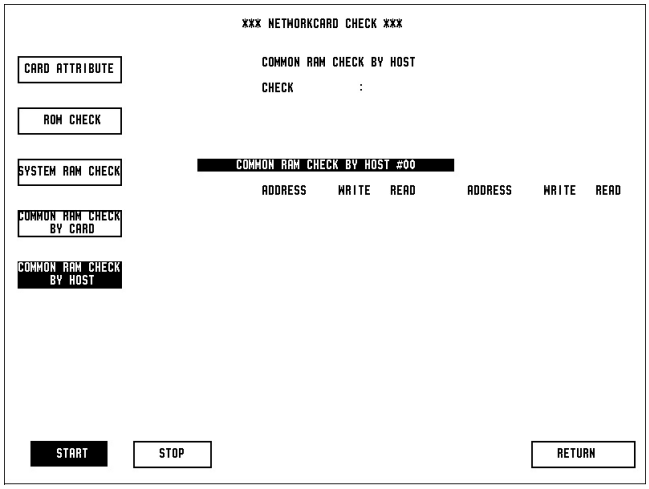
3. Touch the “SYSTEM RAM CHECK” key on the screen. The CPU of the network card checks the system RAM in the CPU by writing the check data as a pattern and reading the stored check data and comparing the written data with the read data. If an error is found, the host CPU on the MAIN board displays the address at the error occurrence, written data and read data on the following screen.



4. Touch the “COMMON RAM CHECK BY CARD” key on the screen. The CPU of the network card checks the common memory of the network card. The host CPU on the MAIN board receives the check result and displays it on the screen. If an error is found, the host CPU displays the address at the error occurrence, written data and read data on the following screen.



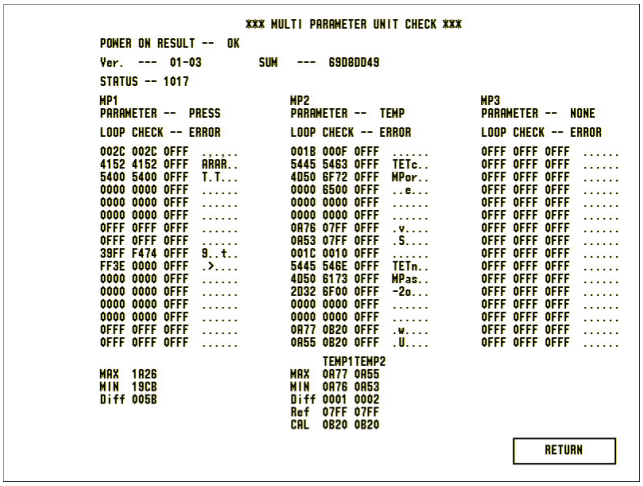
5. Touch the “COMMON RAM CHECK BY HOST” key on the screen. The host CPU on the MAIN board checks the common memory of the network card and displays the check result on the screen. If an error is found, the host CPU displays the address at the error occurrence, written data and read data on the following screen.



6. To return to the MANUAL CHECK MENU screen, touch the “RETURN” key.

MULTI PARAMETER UNIT Check

This item checks the communication with the DPU board, function and accuracy of the multi-parameter inputs. The CPU on the MP2 board sends the check result and multi-parameter socket status data to the DPU board.



Procedure to Start the MULTI PARAMETER UNIT Check Program

To select the MULTI PARAMETER UNIT Check, touch the "MULTI PARAMETER UNIT CHECK" key at the COM CHECK column.

- POWER ON RESULT: Displays the result checked by the CPU on the MP2 board at the power on self check. If an error is found, one of the following error codes appears on the screen.

Error Code	Description	Action
ROM	The ROM on the MP2 board is faulty.	Replace the MP2 board with a new one.
RAM	The RAM on the MP2 board is faulty.	Replace the MP2 board with a new one.
A/D	The A to D converter on the MP2 board is faulty.	Replace the MP2 board with a new one.

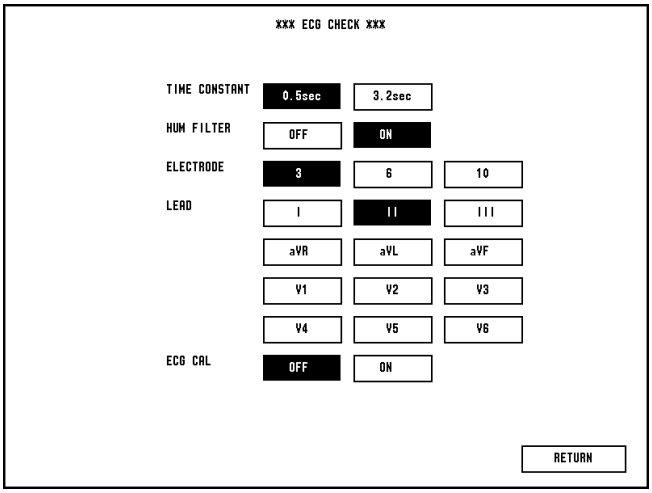
- Ver. and SUM: Displays the software version of the ROM on the MP2 board and its sum data.
- PARAMETER: Displays the vital sign parameter such as PRESS, TEMP, CO_2, RESP, CO or FiO_2 when the corresponding connection cord is connected to each multi-parameter socket. If the socket has no connection cord, "NONE" appears.
- LOOP CHECK: Displays "ERROR" when the one of the connection cords is connected to the socket or no connection cord is connected. Only if the factory use connector for the loop check is connected to the socket, "OK" appears.
- EEPROM data: Displays the data of the EEPROM in the connector of the connection cord when it is connected to the socket. When no connection cord is connected, all the data shows "0FFF". If there is a communication error between the DPU board and CPU on the MP2 board, all the data shows "8000". In this case, the DPU board, motherboard or MP2 board will be faulty.

ECG Check

This check is for factory use.

NOTE

These ECG monitoring settings do not affect the monitor mode.



Recorder and Control Block Checks

This check program checks the thermal array recorder and recorder control block on the MAIN board without communication with the host CPU. Therefore, this check is independent from the manual check menu.

This check allows you to inspect the quality of print, paper speed and feed, etc.

Procedure to start the Recorder and Control Block Check Program

1. To start the check program, press and hold the record key and NIBP INTERVAL key until the monitoring screen appears when you turn on the power. The SELF-TEST-PRO No.1 check program is ready for the execution.

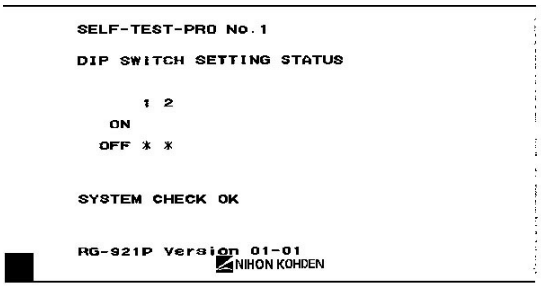
2. To select one of the three check programs for the recorder and control block checks, press the record key. Each time the record key is pressed, the check program changes as follows:
   SELF-TEST-PRO No. 1 → SELF-TEST-PRO No. 2 → SELF-TEST-PRO No. 3 → SELF-TEST-PRO No. 1

3. To start the selected check program, press the NIBP INTERVAL key.

4. To finish these checks, turn off the instrument.

SELF-TEST-PRO No.1

This check program checks the peripheral circuits of the CPU for the recorder control block on the MAIN board, e.g. ROM, RAM and DIP switch setting status. The check result and recorder software version number are recorded on the paper as shown below approx. 30 seconds after the NIBP INTERVAL key is pressed. The recording starts soon after the black square on the paper is detected.



If an error is found, one of the following error codes appears on the paper.

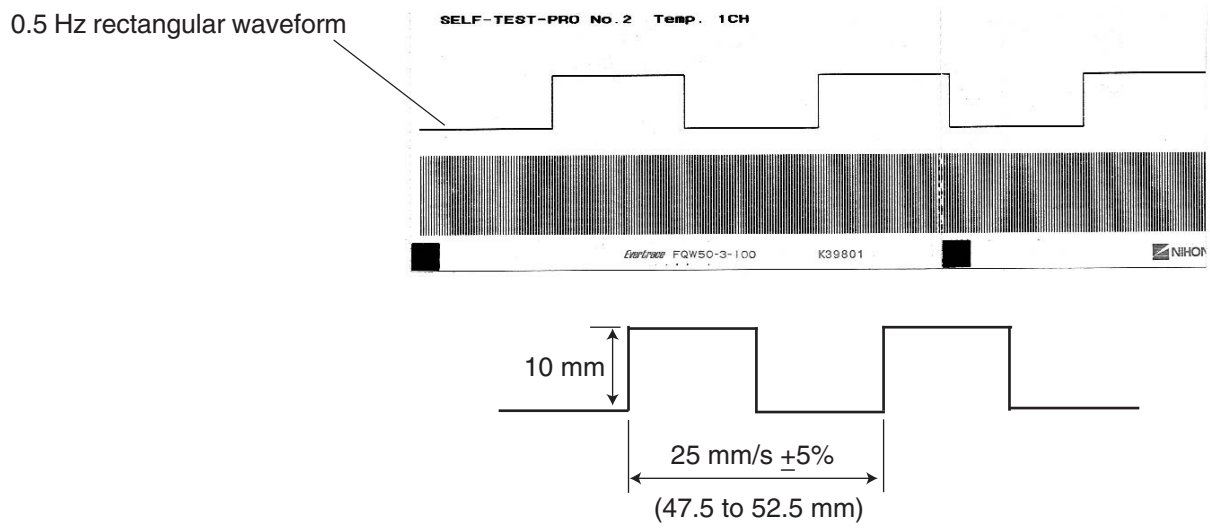
Error Code	Description	Action
ROM	The ROM for the recorder control block on the MAIN board is faulty.	Replace the MAIN board with a new one.
RAM	The RAM for the recorder control block on the MAIN board is faulty.	Replace the MAIN board with a new one.
A/D	The common memory in the RACOON (ASIC) on the MAIN board is faulty.	Replace the MAIN board with a new one.

SELF-TEST-PRO No.2

This check program checks the paper speed, slip and snaking. A 0.5 Hz rectangular waveform and bar graph are recorded on the paper at 25 mm/s paper speed by pressing the NIBP INTERVAL key.

To stop the recording, press the NIBP INTERVAL key again.

25 mm/sec



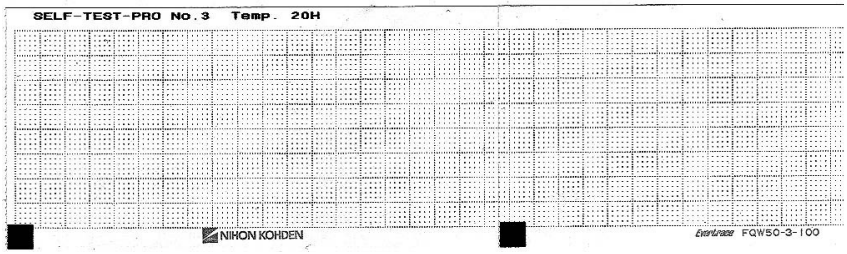
SELF-TEST-PRO No.3

This check program checks the recording quality. There are the following three recording patterns for scale, character and thermal array head checks.
The recording pattern changes automatically after the NIBP INTERVAL key is pressed for the recording start. The recording starts soon after the black square on the paper is detected.

To stop the recording, press the NIBP INTERVAL key again.

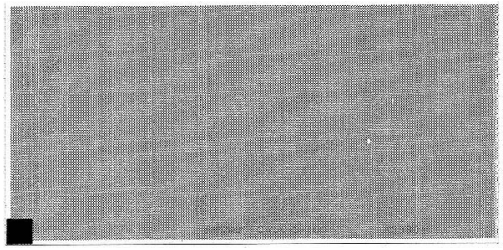
- Scale Check: Checks the circuit related to the scale recording in the recorder control block on the MAIN board. If the recording has something wrong, the MAIN board will be faulty.
- Character Check: Checks the circuit related to the character recording in the recorder control block on the MAIN board. If the recording has something wrong, the MAIN board will be faulty.
- Thermal Array Head Check: Checks the thermal array head condition and RAM for the storage of the data for the heat elements of the head. If there is a dot missing, faint dot or dark and faint dots mixed on the paper, check that the thermal array head is firmly attached and is not dirty. Replace the thermal array head with a new one if the head is cleaned but the problem still occurs. If the recording pattern has something wrong, the MAIN board will be faulty.

Scale Check



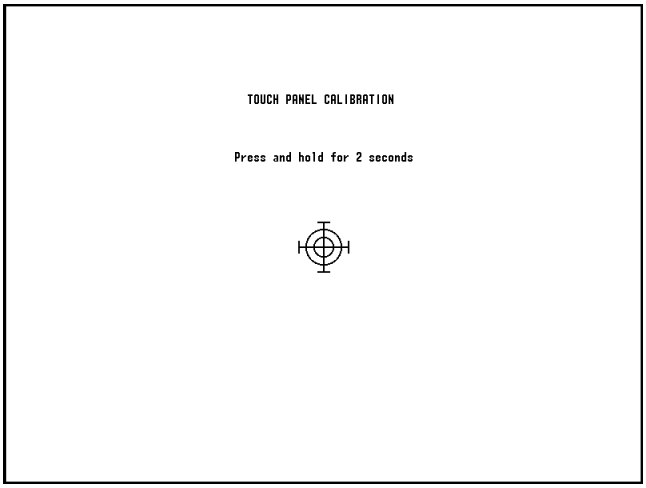
Character Check

Thermal Array Head Check



Calibration of Touch Screen

When you replace the touch screen or MAIN board with a new one, the touch screen must be calibrated. Or, depending on the setting position, the effective point may slightly shift due to viewing angle. In that case, re-calibrate after the instrument is set up.



Procedure to Start the Calibration of TOUCH PANEL

1. To start the calibration of the TOUCH PANEL, call up the DIAGNOSTIC CHECK screen.

2. Press the MENU key to display the TOUCH PANEL CALIBRATION screen.

3. A target mark will be displayed from upper left corner to lower right corner (total of 9 points). Touch the center of the target mark until it moves to the next location.

4. After the calibration, you can confirm the recognized position. Touch anywhere on the screen and the target mark tracks your touching position.

5. To return to the DIAGNOSTIC CHECK screen, press the HOME key.

Section 4 Board/Unit Description

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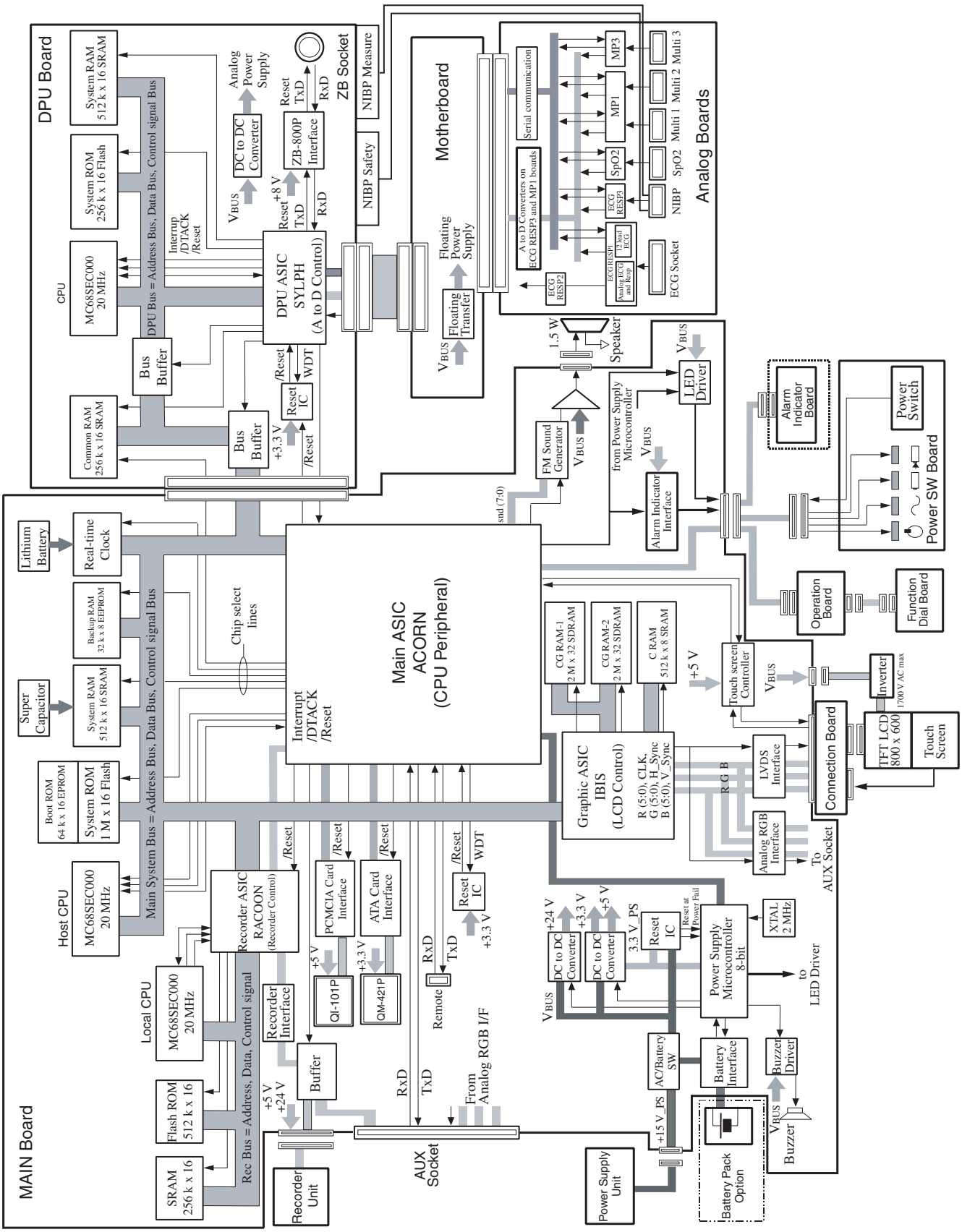
Block Diagram



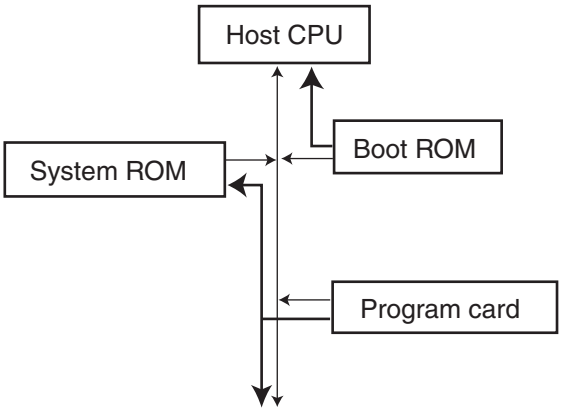
MAIN Board

The MAIN board consists of system control block, display control block, recorder control block and power control block.

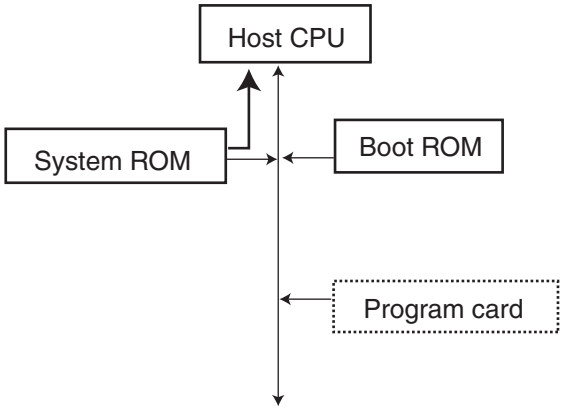
The system control block has the host CPU which gets the operation key status, displays the waveforms and numeric data and controls the recorder unit indirectly. The program is stored in the 2 MB system ROM (flash EEPROM) for host CPU, 128 KB Boot ROM in the system control block, 1 MB system ROM (flash EEPROM) for local CPU in the recorder control block.

When the instrument is turned on, the host CPU executes the program in the Boot ROM. According to the program, the host CPU checks if the program card is inserted into the slot on the MAIN board. When the host CPU recognizes that the correct program card is inserted, the host CPU writes the program from the card to each system ROM. This is called Boot. Therefore, this Boot system allows you to upgrade the instrument without opening it. On the other hand, when the program card is not inserted into the slot, the host CPU switches from the Boot ROM to the system ROM in the system control block and executes the system program.

<When the program card is inserted>



<When the program card is not inserted>



a) System control block

The system control block consists of the host CPU, Boot ROM, system ROM, system RAM, backup RAM, real-time clock, two memory card interfaces, touch screen controller, audio circuit and main gate array.

An MC68SEC000 is used as the host CPU. The clock frequency is 20 MHz. The CPU controls the dedicated gate array, ASIC (Application Specific Integrated Circuit) ACORN, which controls the hard keys, function dials, touch screen, alarm indicator, QRS synchronous sound, alarm sound, real time clock, PCMCIA card interface, DPU communication, RS-232C communication and QM-421P ATA card interface.

The large capacity capacitor (Super capacitor) allows the 1 MB system RAM (SRAM) to back up the trendgraph, vital sign list, arrhythmia recall, monitoring conditions for each parameter and alarm settings for 30 minutes or more after the power is turned off. When the instrument is turned on after more than 30 minutes power off is past, the host CPU regards the backup data as damaged and initializes them.

The 32 KB backup RAM (non-volatile memory) permanently keeps the storage of the system setup conditions and alarm master settings after the power is turned off.

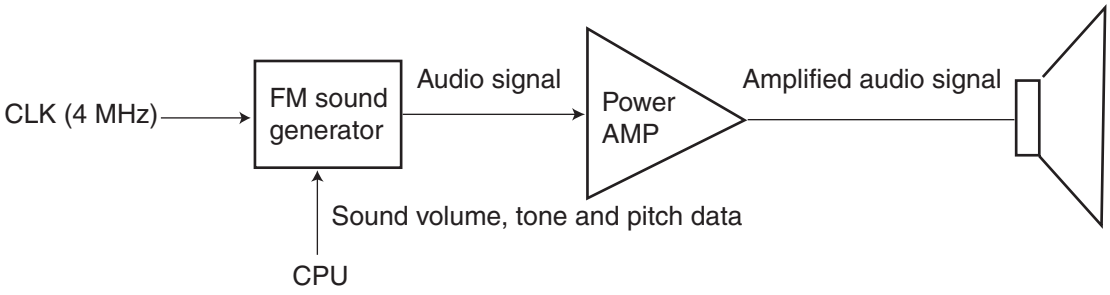
The lithium battery allows the real-time clock IC to update the date and time while the power is turned off. The lifetime of the lithium battery is approx. 6 years or more.

The two memory card interfaces select the bank at every 512 KB and can select the attribute memory or common memory from the memory card.

The host CPU periodically reads the status of all the hard keys on the instrument through the ACORN and executes the process according to the key status. The status of the Record key and NIBP INTERVAL key are also read by the local CPU in the recorder control block. This is used for the recorder and recorder control block checks in the monitoring mode. Refer to Section 3 DIAGNOSTIC CHECK.

The touch screen is controlled by a dedicated microchip controller. When you touch a point on the screen, the microchip controller sends the touch position data to the host CPU through the ACORN with serial data communication.

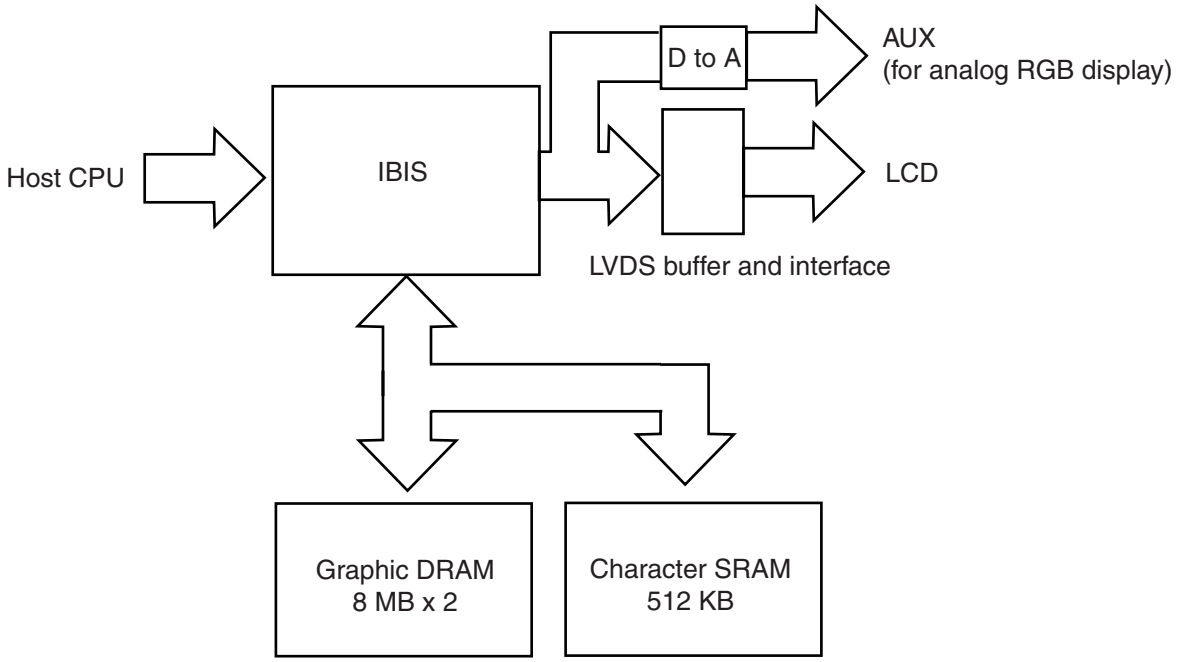
The audio circuit uses an FM sound generator (sound source IC) so that the QRS sound, alarm sound and key sound are generated at the same time. The sound volume control data as well as the tone and pitch data is written to the FM sound generator by the host CPU. The audio output signal from the FM sound generator is amplified by the audio power amplifier so that the speaker sounds.



b) Display control block

The display control block consists of the dedicated graphic ASIC IBIS for entire display control, two 8 MB DRAMs for display of waveform and graphic data, 512 KB high-speed SRAM for display of alphanumeric data and display interfaces for the LCD and an external RGB monitor.

When the IBIS receives a display control command from the host CPU, the IBIS accesses these memories to get the display data and arranges the display data for RGB outputs. There are two RGB outputs. One is RGB output for the LCD through the LVDS (Low Voltage Differential Signaling) interface. The other one is RGB output for a locally available RGB monitor. The LVDS interface which is different from a CMOS or TTL display interface uses approx. 0.3 V peak-to-peak differential signal in serial data communication.

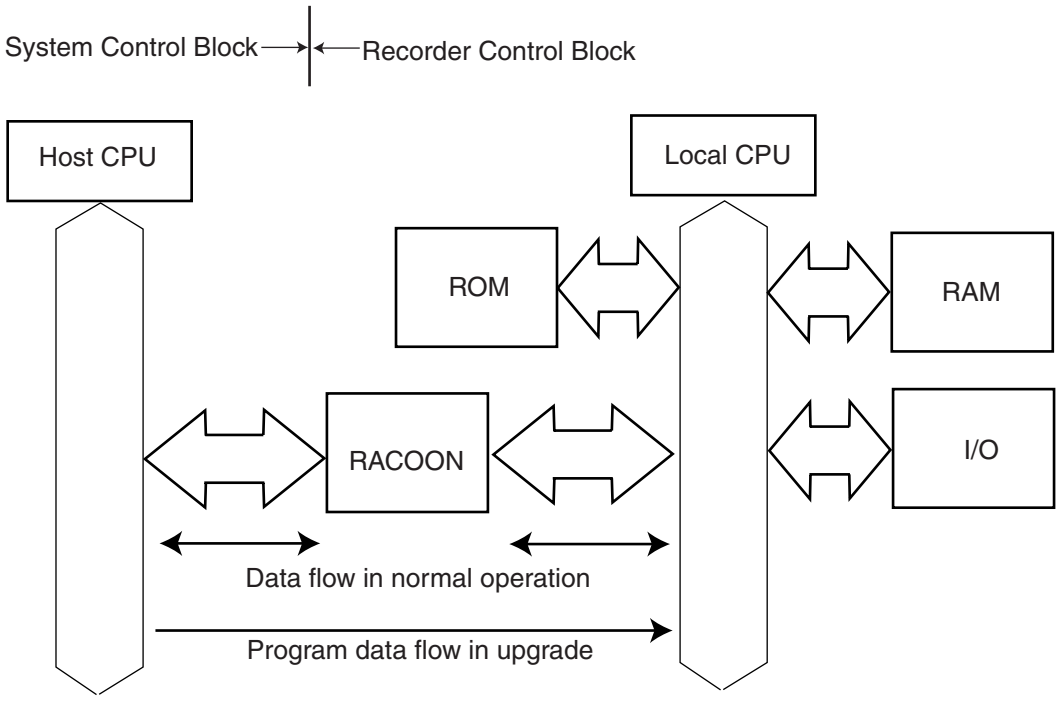


c) Recorder control block

The recorder control block consists of the local CPU (16 MHz MC68SEC000), 1 MB system ROM for program storage, 512 KB system RAM for the local CPU working area and the dedicated recorder control ASIC RACOON.

The local CPU accesses the ROM or RAM through the RACOON. When the RACOON receives a recorder control command from the local CPU, the RACOON accesses the RAM to get the recording data and controls all the recording functions such as the motor and thermal array head in the recorder unit.

When the instrument is upgraded, the local bus in the recorder control block is directly connected to the system bus (in the system control block) and the 1 MB system ROM takes a part of the memory for the upgrade program.



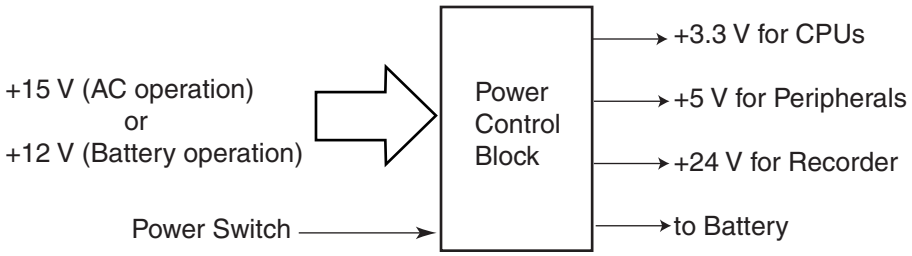
d) Power control block

The power control block consists of the power supply microchip controller, DC/DC converters, buzzer and its driver and battery interface.

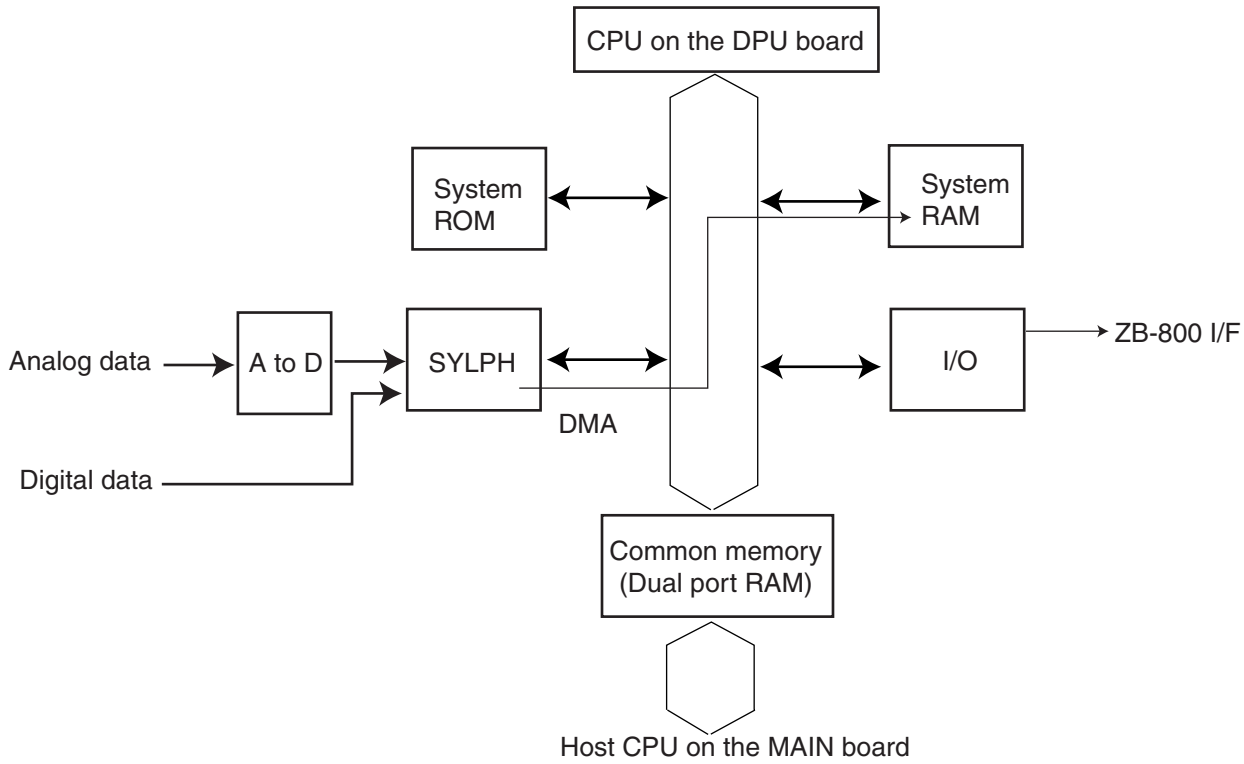
+15 V from the power supply unit or +12 V from the rechargeable battery is converted to +3.3 V, +5 V and +24 V supply voltages by the DC to DC converters and power supply microchip controller.

When the line voltage is supplied to the instrument and the battery is inserted into the instrument, the power supply microchip controller charges the battery with approx. 190 mA (normal charge) for 15 hours. After the 15 hours, the controller uses trickle charging to charges the battery with approx. 60 mA so that the fully charged battery condition is maintained.

If the normal or trickle charging is interrupted for one hour or less by power failure or disconnection of the power cord and the battery is not removed from the instrument, the controller memorizes how many hours the battery is charged before the interruption. After it is removed, the controller charges the battery under the memorized condition to protect the battery against excessive charge.



DPU Board



The DPU board receives the vital sign information (analog signal or digital data) from the analog boards such as ECG RESP1 board and MP1 board.

The CPU on the DPU board executes the primary processing of the vital sign information.

All the analog signals for the vital sign parameters are multiplexed and converted to the digital data along the multiplexing timing. The DMA assigned each vital sign parameter data into the individually specified area of the 1 MB SRAM on the DPU board. The digital data converted from the vital sign analog signal at one of the analog boards is sent to the bus on the DPU board with serial data communication. This digital data is also assigned into the individually specified area of the 1 MB SRAM by the DMA.

MC68SEC000 is used as the CPU. The clock frequency is 20 MHz. The CPU controls the dedicated gate array ASIC (SYLPH) which is used as the data process controller to control the A to D converter and the DMA and to mediate between the accesses from the host CPU on the MAIN board and from the CPU on the DPU board to the common memory (dual port RAM). The SYLPH has an I/O port.

Flash EEPROM is used as the system ROM on the board. The system ROM can be programmed by the host CPU at the Boot. Refer to “MAIN Board” section.

ZB-800P interface and ECG/BP output circuits are provided on the board. These circuits send out the analog signals with almost no delay. Especially, the ECG/BP output circuit acquires ECG and BP analog signals from the ECG/RESP and multi-parameter 1 sockets on the front panel. The ECG analog signal is directly sent to the ECG/BP OUT socket without multiplexer. The BP analog signal is directly sent to the ECG/BP OUT socket after the MP1 board receives the zeroing data from the CPU on the DPU board. These analog signal outputs do not require any process with CPUs on the MAIN board and CPU on the DPU board.

Motherboard

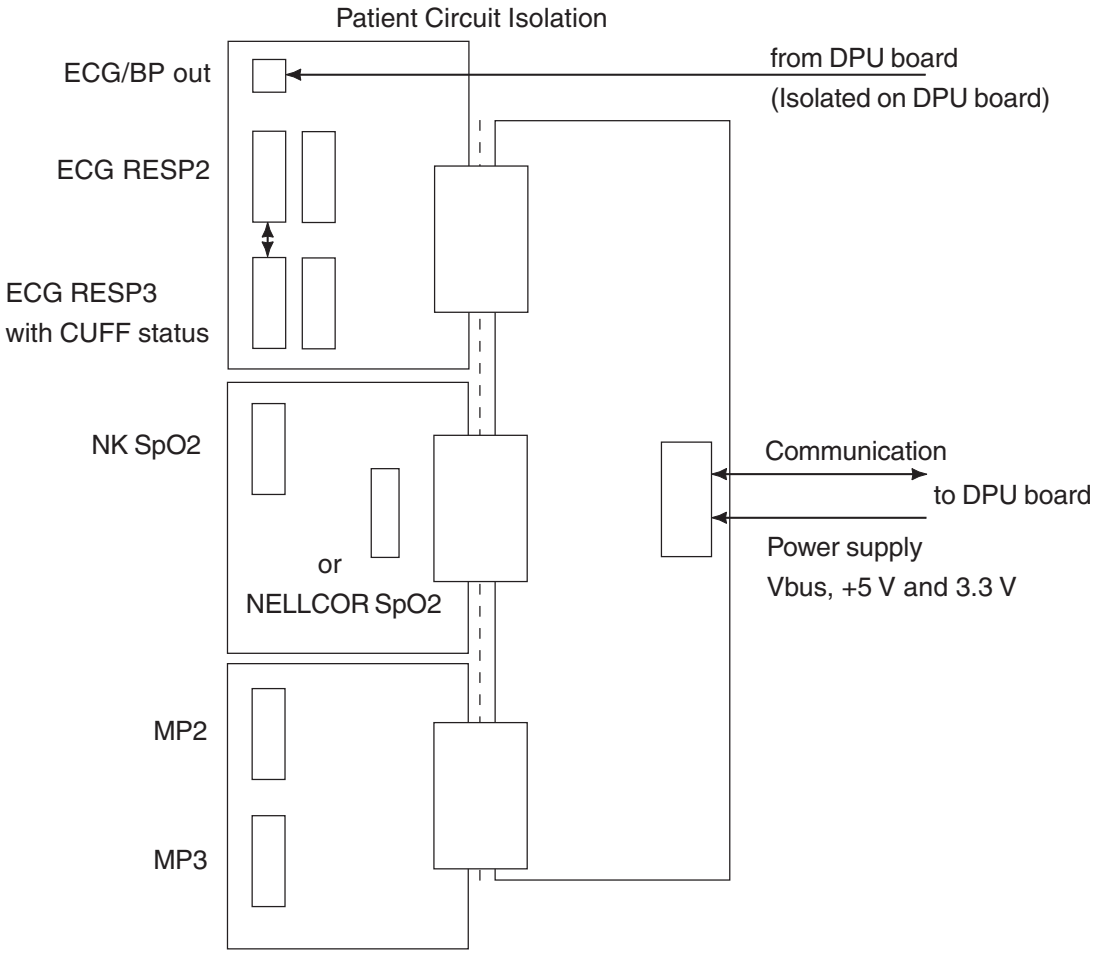
The motherboard isolates the analog boards such as ECG RESP1 to 3 boards, SpO_2 board and MP1 to 3 boards from the ground. The motherboard supplies the isolated power to each analog board. The motherboard transfers the vital sign signals from the analog boards to the DPU board. The motherboard transfers the control signals from the DPU board to the analog boards.

The motherboard lets the two ECG RESP1 to 3 boards communicate. The ECG and respiration waveforms (analog signals) for arrhythmia detection and screen display are multiplexed on the motherboard and sent to the DPU board. 12 lead ECG signals digitized on the ECG RESP3 board are transferred to the DPU board.

The status signal of NIBP cuff size for adult/child or neonate is transferred to the DPU board together with ECG floating status communication.

The voltages (analog signals) measured for SpO_2 are multiplexed at 2 ms interval on the SpO_2 board. The multiplexed analog signals are sent to the DPU board through the motherboard.

The vital sign input signals on the MP1 to 3 boards are digitized by the A to D converter controlled by the CPU on the MP2 board. The digital data is transferred to the DPU board through the motherboard.

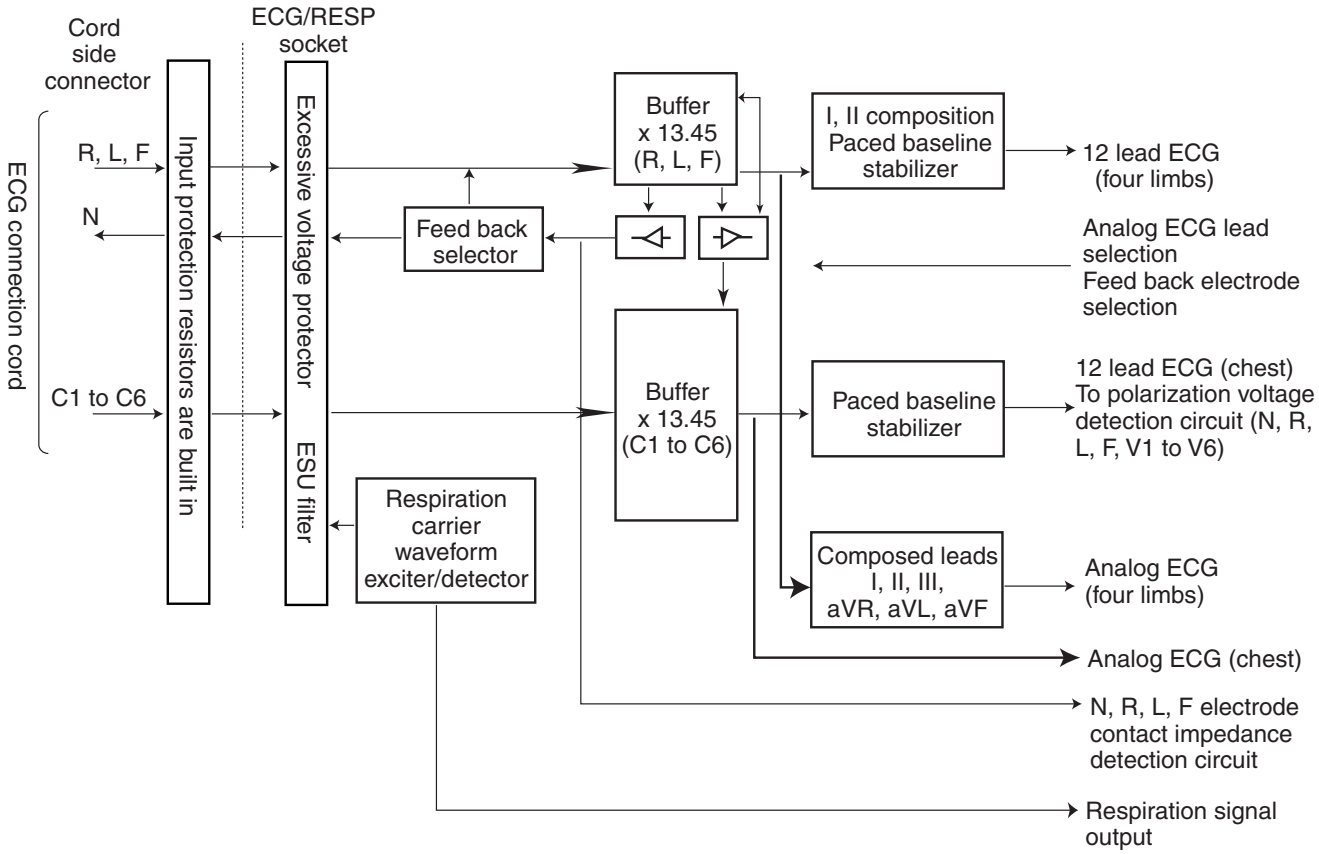


ECG RESP1, ECG RESP2 and ECG RESP3 Boards

These three boards process the ECG and impedance method respiration signals.

There are two ECG processing circuits on the ECG RESP1 board. One is ECG analog signals for arrhythmia analysis and screen display which are selectable with the lead select function. The other one is digital ECG data for 12 lead ECG display and analysis which is digitized by the A to D converter in the CPU on the ECG RESP3 board.

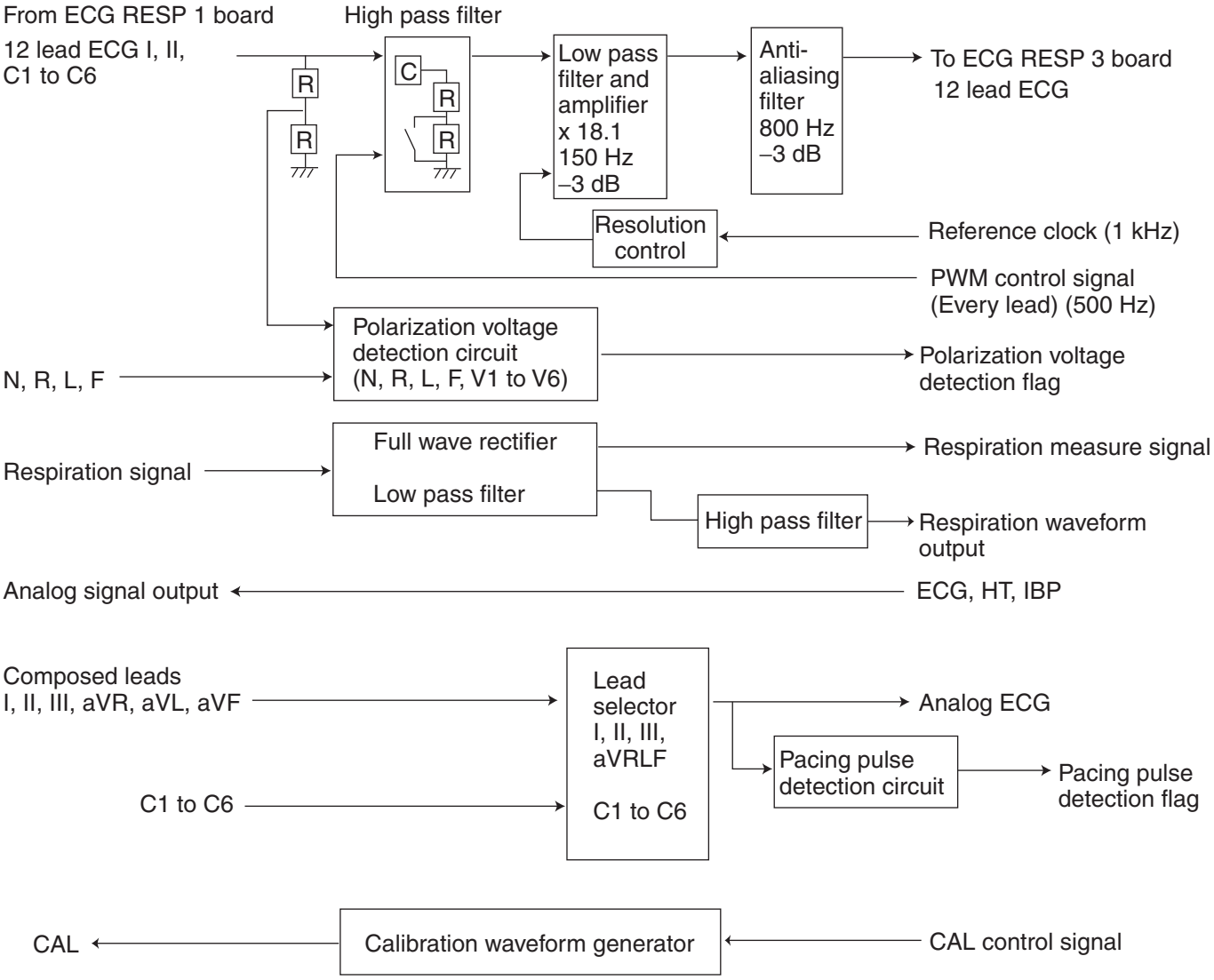
The ECG RESP1 board has the impedance method respiration exciter and detection circuits. These circuits outputs the voltage (respiration signal) which varies proportionally to the impedance including the electrode contact impedance between the two electrodes on a patient's chest.


Cord side connector
ECG/RESP socket
ECG connection cord
R, L, F
N
C1 to C6
Input protection resistors are built in
Excessive voltage protector
ESU filter
Feed back selector
Buffer x 13.45 (R, L, F)
Buffer x 13.45 (C1 to C6)
I, II composition Paced baseline stabilizer
Paced baseline stabilizer
Composed leads I, II, III, aVR, aVL, aVF
Respiration carrier waveform exciter/detector
12 lead ECG (four limbs)
Analog ECG lead selection
Feed back electrode selection
12 lead ECG (chest)
To polarization voltage detection circuit (N, R, L, F, V1 to V6)
Analog ECG (four limbs)
Analog ECG (chest)
N, R, L, F electrode contact impedance detection circuit
Respiration signal output

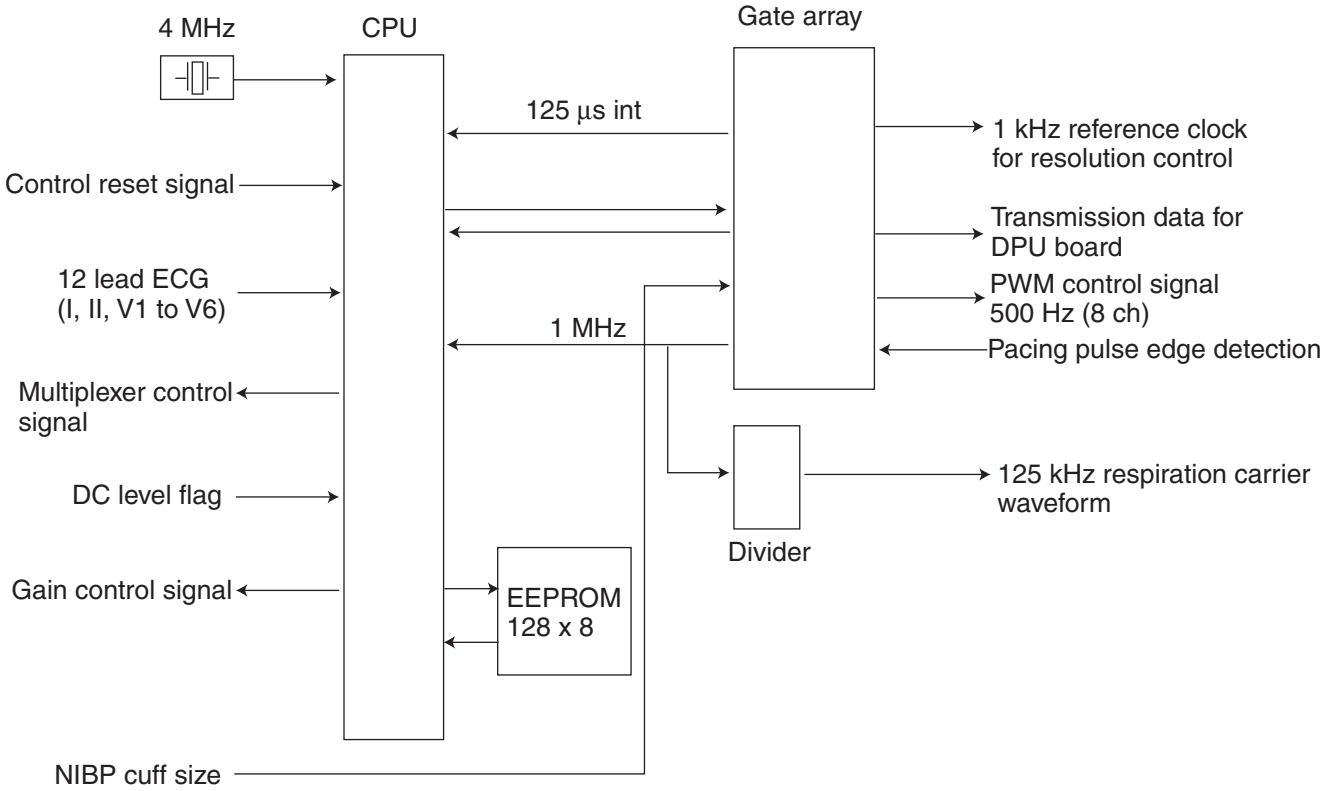
The ECG RESP2 board has the high-pass filter (for 12 lead ECG), low-pass filter (for 12 lead ECG) and polarization voltage detection circuit.

The lead for arrhythmia analysis is selected on this board. The ECG analog signal on the selected lead for arrhythmia analysis goes to the ECG RESP3 board.

Since the respiration signal is proportional to the impedance between the two electrodes, the respiration circuit sends a measurement status signal to the CPU on the ECG RESP3 board according to the impedance level. The respiration circuit has the high-pass filter so that the respiration waveform is obtained.



The ECG RESP3 board has the high-pass filter (for the selected lead ECG analog signal at the amplifier final stage), low-pass filter (for the selected lead ECG analog signal at the amplifier final stage) and A to D converter (for 12 lead ECG) in the CPU for primary data processing. There is a supply voltage control circuit to adjust the 12 lead ECG sensitivity. The NIBP cuff size (adult/child or neonate) sensor (hall element) is provided on this board. The status signal from the sensor goes to the gate array on this board and is transferred to the DPU board through the motherboard.

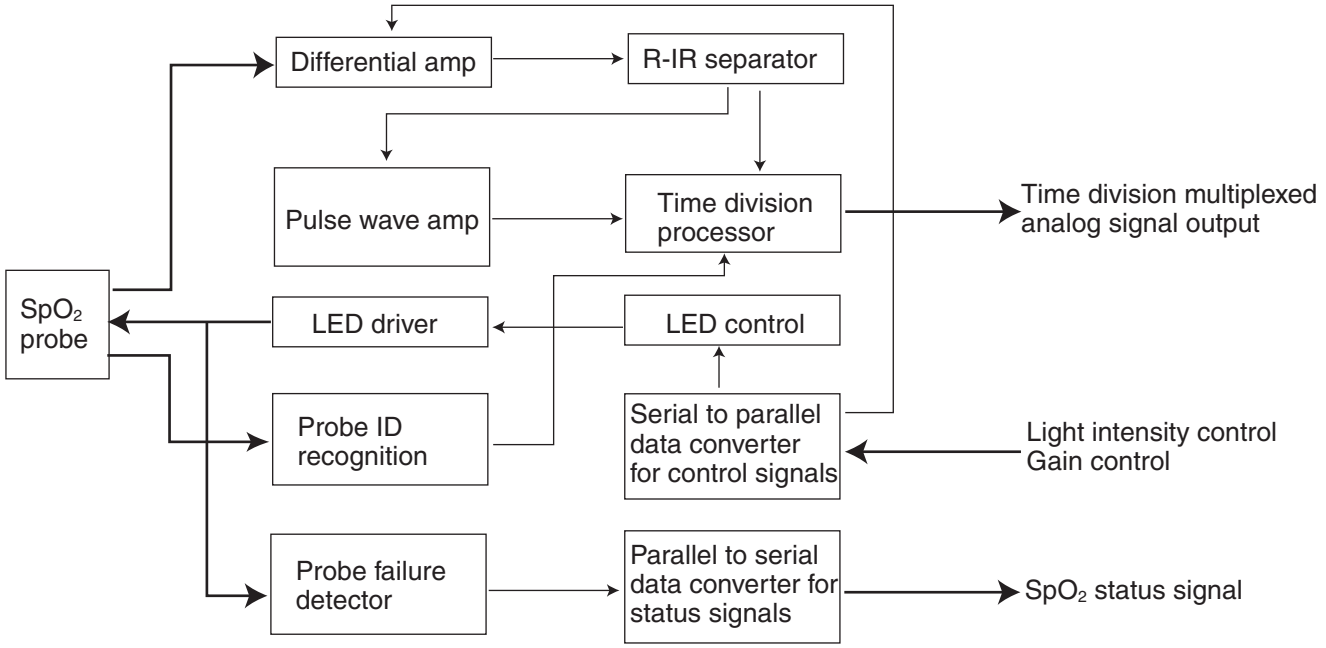


NK SpO_2 Board and Nellcor SpO_2 Module

NK SpO_2 Board

This board consists of the following blocks.

- Differential amplifier block for the electrical signals detected by the photodiode when the red LED and infrared LED in the SpO_2 probe alternatively transmits the lights to the subject
- Red and infrared related signals separator block
- Pulse wave amplifier block
- Time division multiplexed analog signal block
- LED drive current control block
- Probe ID recognition block
- Probe failure detection block



Nellcor SpO_2 Module

The module covers all the abovementioned blocks in the NK SpO_2 board. The module sends the SpO_2 data and status data to the DPU board through the motherboard by serial data communication.

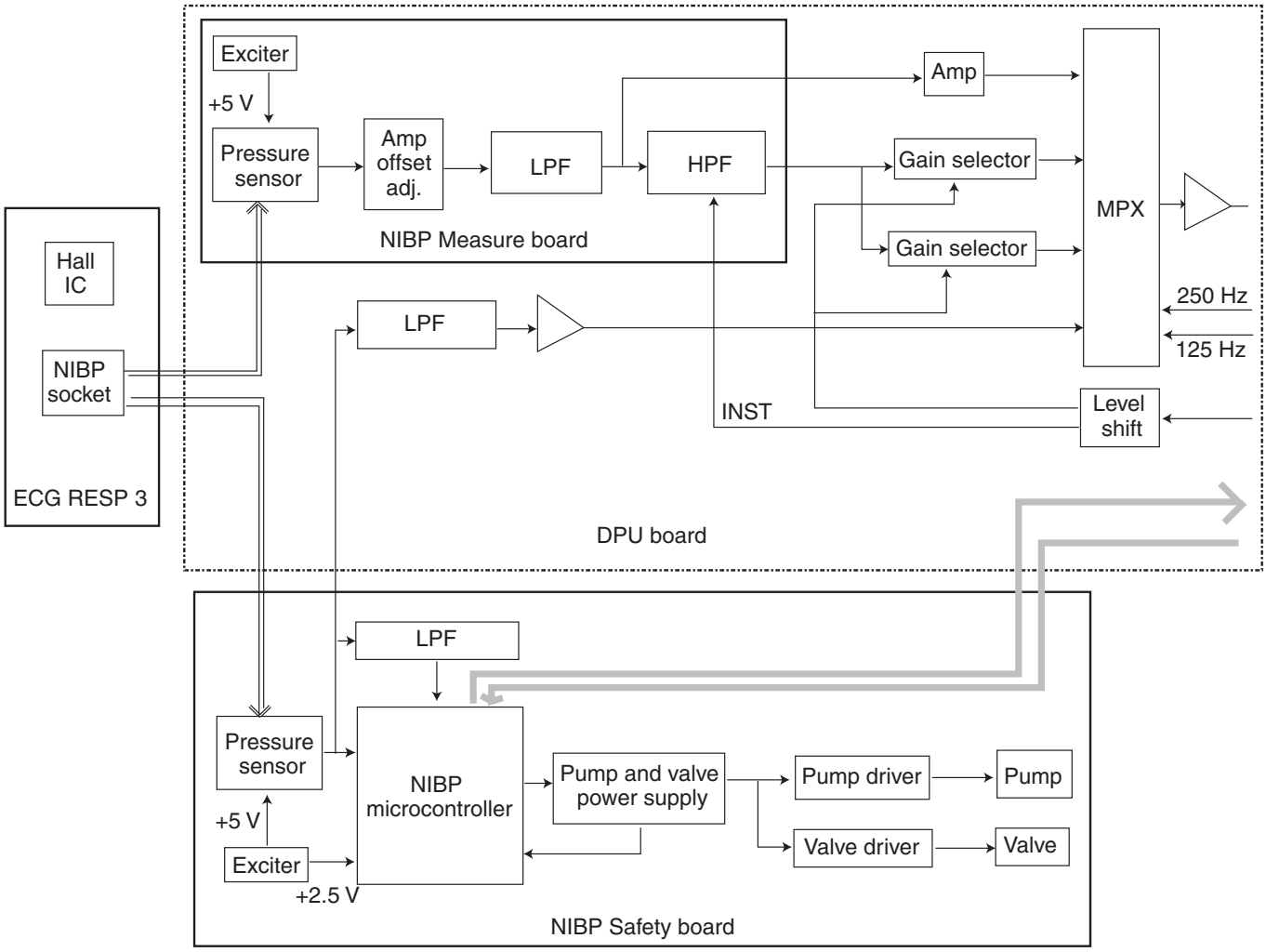
NIBP Measure Board and NIBP Safety Board

The NIBP Measure board has the pressure sensor for NIBP measurement to detect the cuff pressure and convert it to an electrical signal.

The NIBP Safety board consists of a microcontroller for safety control, pressure sensor, solenoid valve, pump and power supply cut-off circuit for the valve and pump. This board as well as the NIBP Measure board individually monitors the cuff pressure. If a wrong operation such as excessive cuff inflation caused by the NIBP Measure board occurs, the NIBP Safety board provides the multi safety functions so that the patient is protected from the wrong operation.

When the microcontroller works for the safety, the drive voltage is not supplied to the pump and valve for 30 seconds. This prevents the cuff from inflating during this period.

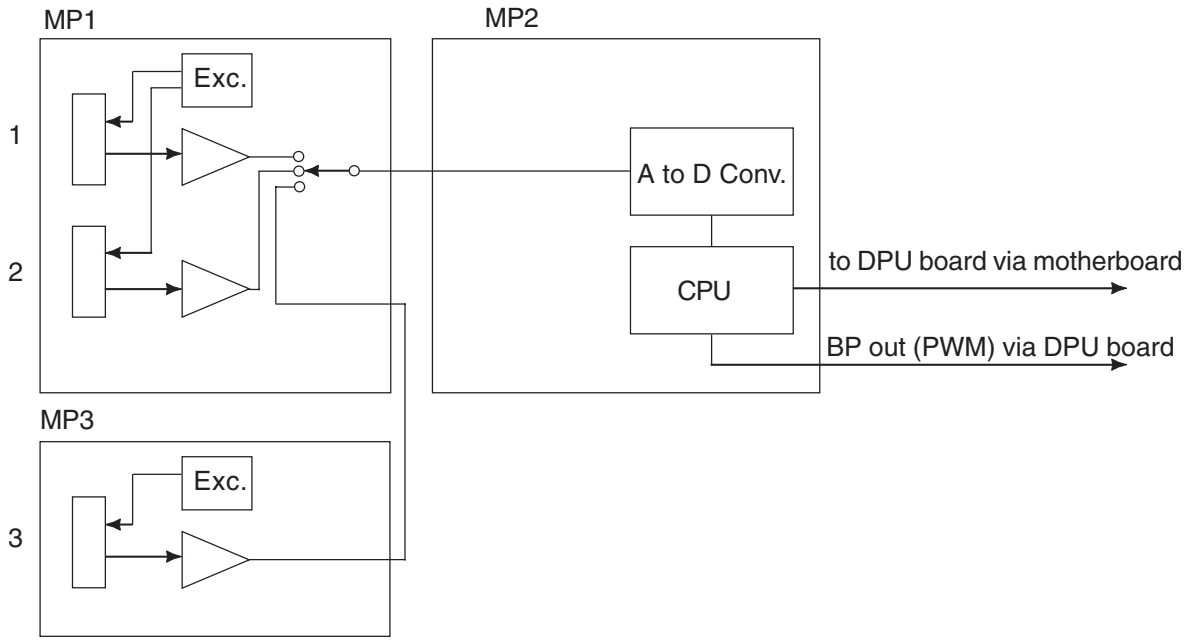
Since the measurement data from the NIBP Measure board and NIBP Safety board are compared and safety circuit operation is always monitored, the “Safety Circuit Error” status message immediately appears on the screen if the NIBP measurement has something wrong.



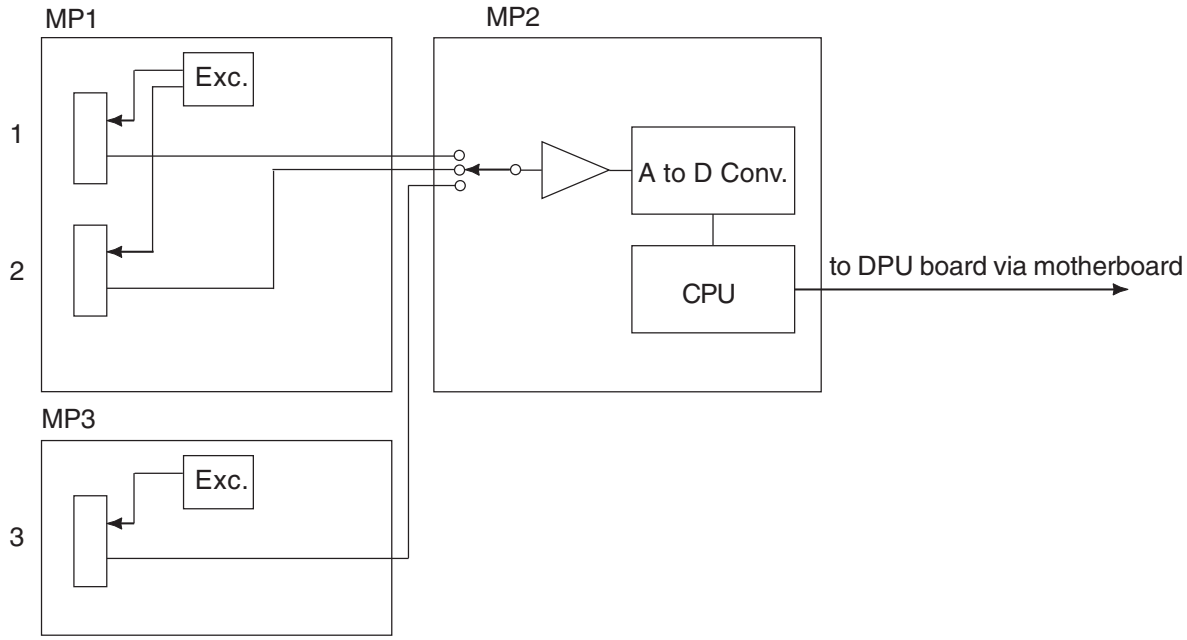
MP1, MP2 and MP3 Boards

The MP1 and MP3 boards have universal input sockets. The MP1 board has two input sockets but the MP3 board has one or no socket depending on the instrument model number.

The MP1 board and the one input socket MP3 board have an input protection circuit, invasive blood pressure amplifier, thermistor probe method respiration input preamplifier, each transducer/sensor internal wire cut detection circuit, exciter circuit and its power supply circuit, excessive current protection circuit, communication circuit for the EEPROM in the connection cord connector and asynchronous communication circuit for CO_2 sensor.



The MP2 board acquires the analog signals from the MP1 and MP3 boards and has the preamplifier for CO, temperatures and FiO_2 input signals. These analog signals are converted to digital signals on the MP2 board. The communication control circuits for the EEPROM in the connection cord connector and CO_2 sensor are also on this board.



Recorder Unit (for BSM-4101/4102/4103/4104 only)

The recorder unit consists of thermal array head, paper drive motor, photo sensor, gears, recorder chassis, sensor board and sensor control board.

The RACOON (ASIC) on the MAIN board allows the recorder unit to record the 3 channel waveforms, vital sign list and trendgraph.

Since the thick membrane type thermal array head is used, the adjustment of the supply voltage to the head is not required. The lifetime of the heating elements on the head is 100 million heating times.

A stepping pulse motor is used as the paper drive motor. The lifetime of the motor is approx. 3000 hours continuous operation.

When the LED and photo sensor set on the sensor board is replaced with a new one, the sensor control VR must be adjusted. See Section 7 ADJUSTMENT.

Power Supply Block

The power supply block consists of the power supply unit (+15 V DC output), heat sink chassis, fuse holder built-in type AC inlet socket, ground terminal and line frequency detection coil. Refer to Section 8 REPLACEABLE PARTS LIST.

This power supply unit same as in the BSM-1101/1102, BSM-2301 and WEP-4204/4208 is used.

LCD Unit

12.1 inch TFT color LCD which has 800 dots × 600 dots (SVGA) is used as the display. This LCD unit can display maximum 512 colors. 12 colors can be assigned for waveforms and each vital sign parameter by the user.

Since the LCD unit is covered with a polarization filter which is weak against impact and pressure, it requires your attention during service.

The LCD unit has two cold cathode tubes to backlight the LCD. The high voltage for the two tubes is supplied from the inverter board.

It takes approx. 25,000 hours (about 2 years and 10 months) or 50,000 hours (about 5 years and 9 months for the monitors with the revision number CA or later) for the brightness to decrease from maximum to half brightness (lifetime of the backlight) if the two tubes at the maximum brightness work in continuous operation. Therefore, the tube may need to be replaced after 25,000 hours or 50,000 hours (for monitors with the revision number CA or later) of use.

Section 5 Disassembly and Assembly

Before You Begin 5.1
Warnings and Caution 5.1
Required Tools 5.1
Opening the Instrument 5.2
Removing the Nellcor SpO_2 Module (MP304*) 5.6
Removing the Nellcor SpO_2 Module (MP506*) 5.7
Removing the NIBP Safety Board 5.8
Removing the Motherboard, NIBP Measure Board 5.10
Removing the DPU Board 5.12
Removing the MAIN Board 5.13
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The procedures in this section tell how to remove, replace and install the major components in the instrument.

Before You Begin

Removing, replacing and installing the major components should be done by qualified service personnel.

Warnings and Caution

WARNING

- **To avoid the possibility of injury to yourself or damage to the instrument, do not install or remove any component or change the internal switch settings while the power is on. After the power is off, wait a few minutes before disassembling the instrument.**
- **To avoid accidental discharge of static electricity, which could damage the instrument components, use a wrist ground strap when installing or removing any component.**

CAUTION

Fuses cut off the power when an abnormality occurs in the instrument. Eliminate the malfunction before replacing the fuse. Use the correct fuse only. The fuse rating is shown on the holder.

Required Tools

Anti-static bench mat
Anti-static wrist strap
Flat-blade screwdriver (insulated type)
Phillips screwdriver (insulated type)
Allen wrench or hexagon keys
Hex socket driver
Tweezers
Nippers
Cable binder

Opening the Instrument

1. Turn off the instrument.

2. Disconnect the power cord from the instrument and remove the battery from the instrument.

3. Remove the rubber cap from each end of the handle by popping the cap out with a flat-blade screwdriver. A hexagonal head screw is under each cap.

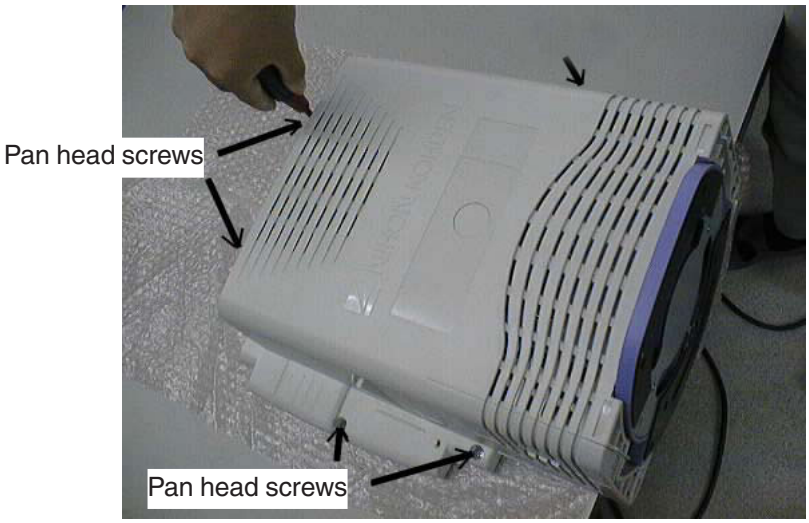
4. Use a 5 mm Allen wrench to remove the 2 hexagonal head screws which secure the handle. Remove it from the instrument.

CAUTION

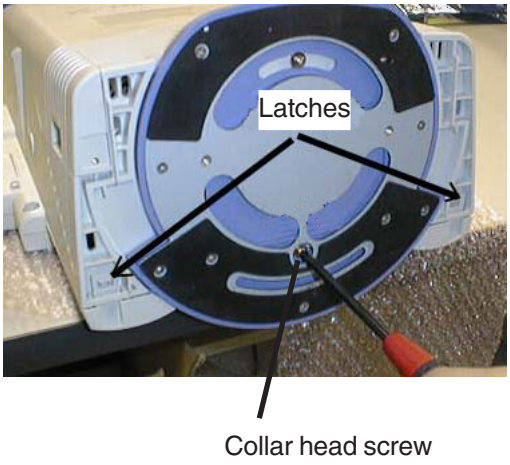
Before placing the instrument on a table, if its surface is dirty, hard or rough, cover the table with a clean, soft and smooth material to avoid making the screen dirty or damaging the screen.

5. Put the instrument on the work table so that the rear side is up and the bottom part of the instrument extends beyond the table edge.

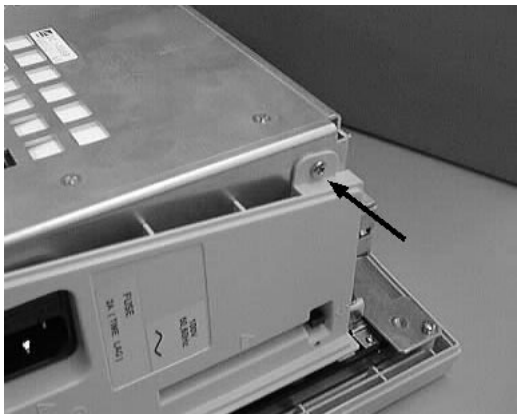
6. Remove the 5 pan head screws from the rear enclosure.



7. Remove the collar head screw with spacer from the bottom of the instrument. Release the latches on the bottom corners of the instrument and slowly and carefully lift the rear enclosure to open the instrument and expose the chassis block.



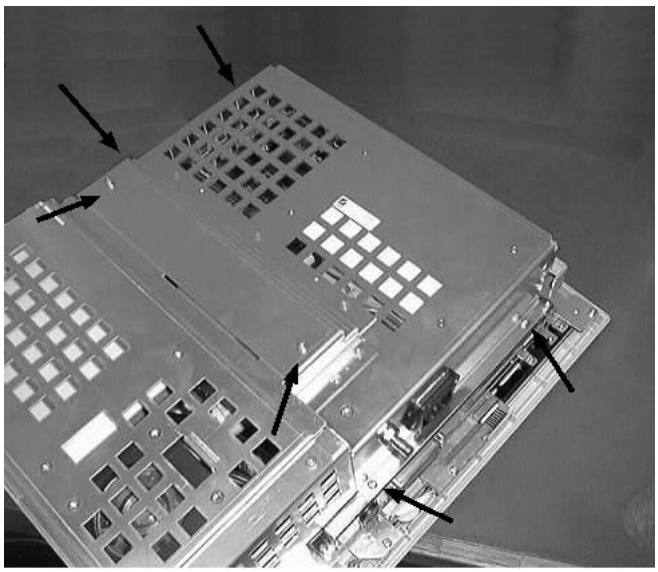
8. Remove the binding head screw which secures the side panel to the upper chassis (power chassis) cover. Remove the side panel from the instrument. 2 screws are visible under the side panel.



NOTE in Assembling the Instrument

Check that the binding head screw which was removed in step 8 is used to secure the side panel.
The binding head is slightly bigger than a pan head so more torque can be applied to the side panel with the binding head screw.

9. Remove the 6 screws which secure the upper chassis cover.



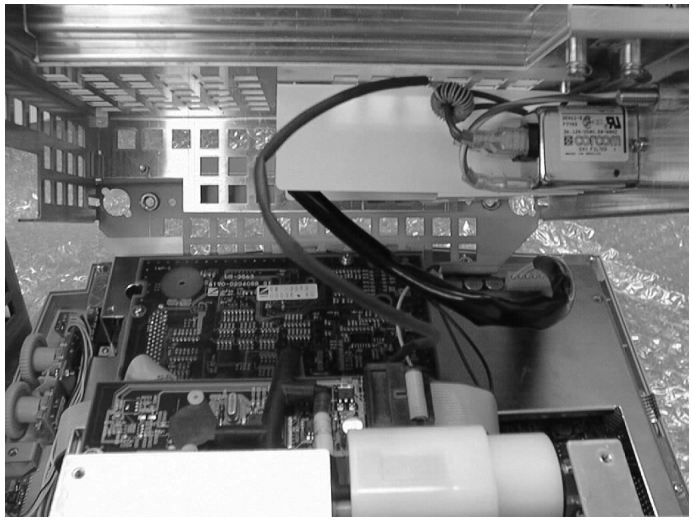
10. Carefully lift the upper chassis cover up and disconnect the following cables from the specified sockets. Remove the upper chassis cover.
    - Disconnect the cable between the power supply unit and MAIN board from CN105 socket on the MAIN board.
    - Disconnect the cable between the AC inlet socket and DPU board from CNJ031 socket on the DPU board. This cable has a toroidal core for line frequency detection.

CAUTION

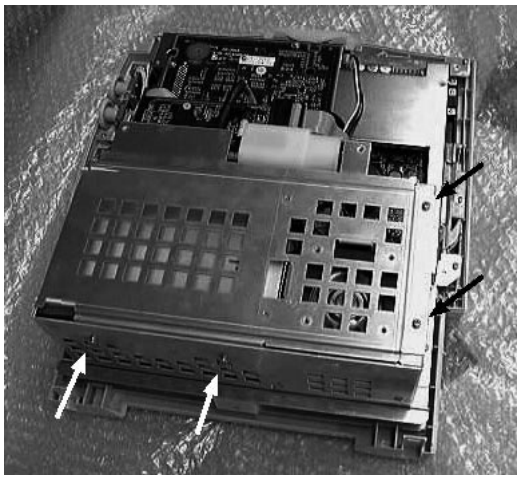
Pull the connector housing to disconnect the cable. If the cable is pulled, the wires inside the cable can be cut near the connector.

NOTE in Assembling the Instrument

Make a note of how the cables are arranged in the instrument.



11. Remove the 4 screws which secure the lower chassis cover as shown below. Carefully lift it up and disconnect the cable between the battery receptacle terminal and MAIN board from CN021 on the MAIN board. Remove the lower chassis cover.

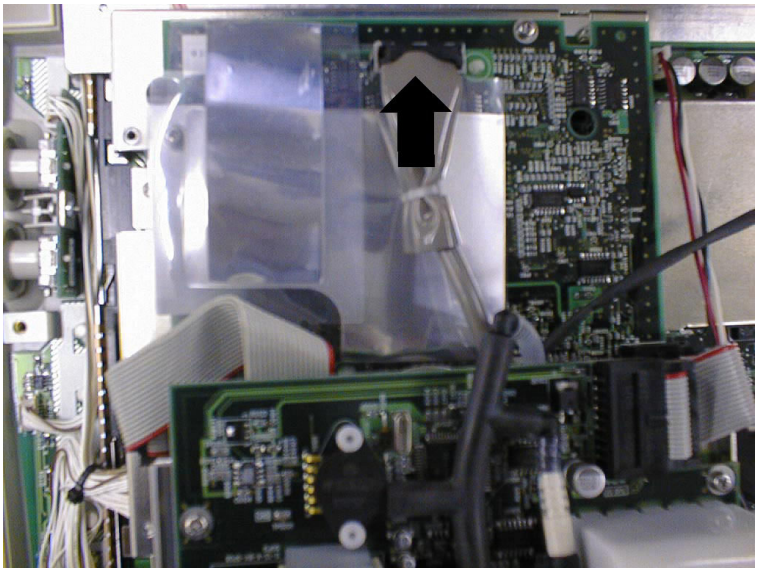


Removing the Nellcor SpO_2 Module (MP304*)

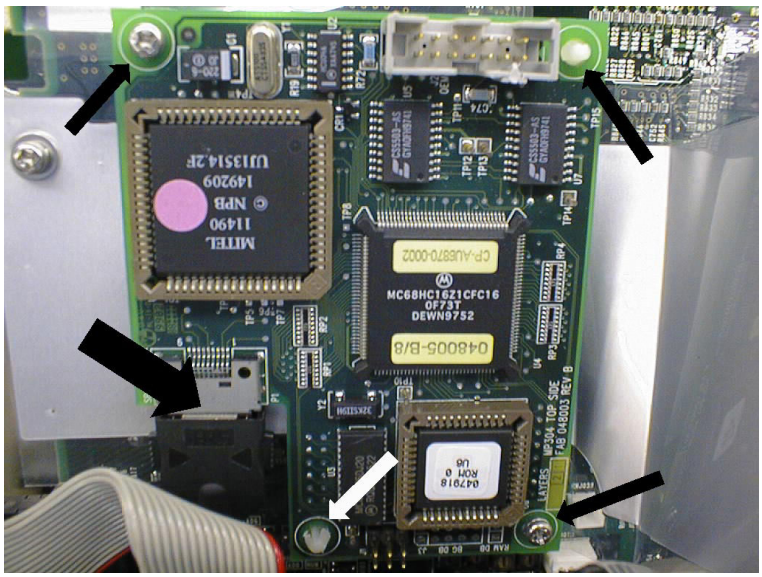
*** When the MP304 SpO_2 module is built in, there is no indication of "NELLCOR OxiMax". Refer to page 1.20 "On the BSM-4102/4104/4112/4114 Monitors".**

Perform the following procedure after the "Opening the Instrument" procedure.

1. Disconnect the connection cable (MP304 J2) marked with an arrow from the SpO_2 module. Open the shield sheet which covers the SpO_2 module.



2. Remove the 2 screws and disconnect the connection cable marked with an arrow from the SpO_2 module. Remove the 2 plastic board retainers from the SpO_2 module with a tweezers. Remove the SpO_2 module.



NOTE in Assembling the Instrument

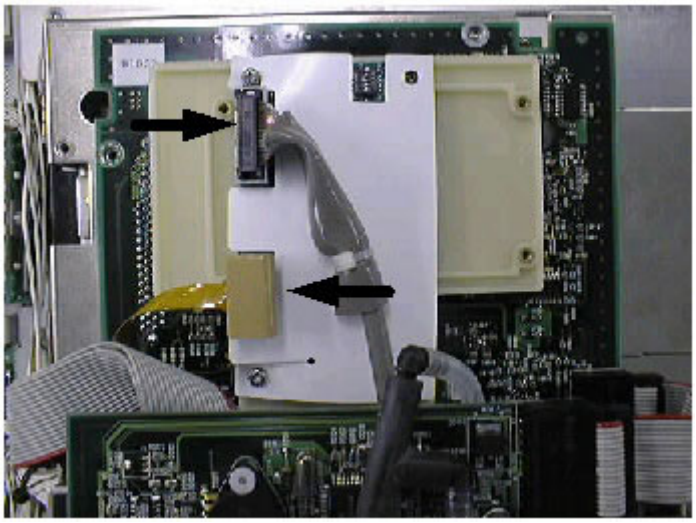
When replacing the SpO_2 module with a new one, remove the 2 jumpers W1 and W2 from the J1 part of the new SpO_2 module.

Removing the Nellcor SpO_2 Module (MP506*)

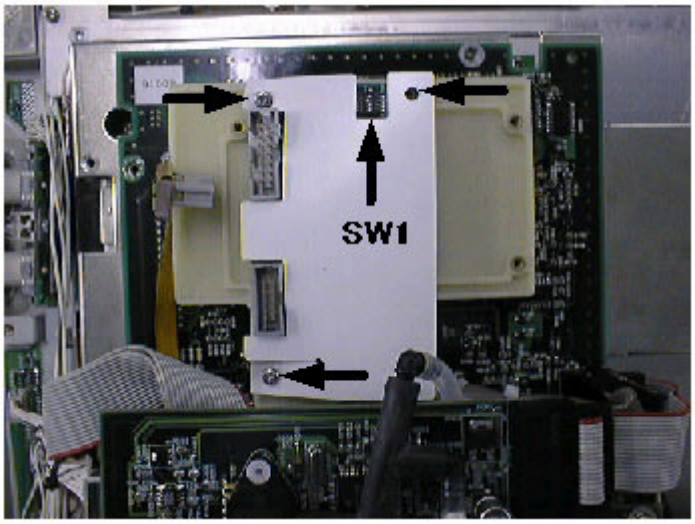
*** When the MP506 SpO_2 module is built in, "NELLCOR OxiMax" is indicated below the SpO_2 socket on the front panel. Refer to page 1.20 "On the BSM-4102/4104/4112/4114 Monitors".**

Perform the following procedure after the "Opening the Instrument" procedure.

1. Disconnect the 2 connection cables at the J1 and J2 connectors on the MP506 marked with an arrow.



2. Remove the 3 screws which secure the SpO_2 module. Remove the SpO_2 module and insulator from the instrument.



NOTE in Assembling the Instrument

When replacing the SpO_2 module with a new one, check that each bit switch of the SW1 DIP switch on the new board is set as shown below.
No. 1, 2 and 4: OFF
No. 3: ON

Removing the NIBP Safety Board

Perform the following procedure after the “Opening the Instrument” procedure.

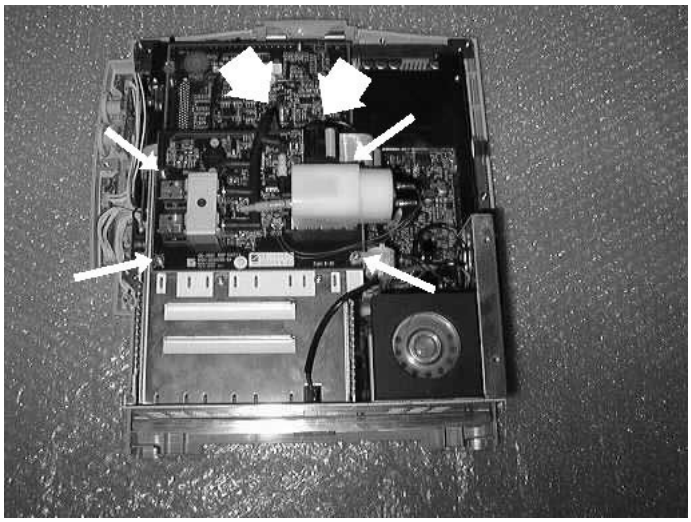
1. Disconnect the air tube from the joint on the NIBP Safety board.

2. Disconnect the cable between the NIBP Safety board and DPU board from the CNJ201 socket on the NIBP Safety board.

3. Remove the 4 screws which secure the NIBP Safety board. Remove the board.

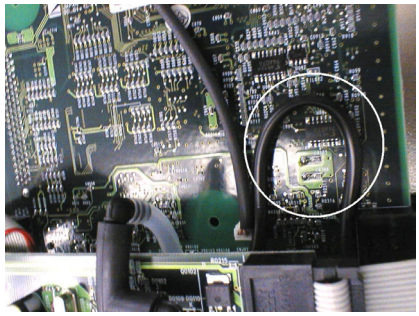
NOTE in Assembling the Instrument

Since the screw which secures the ferrite core for the analog output has a slightly longer shaft and flat washer, be careful not to use the wrong screw for the core.

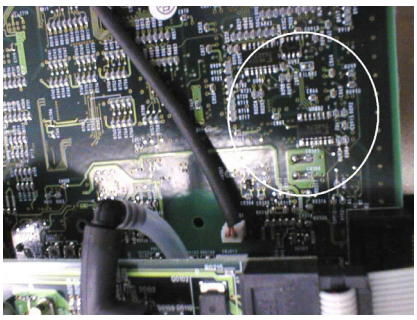


CAUTION in Assembling the Instrument

When you fasten the NIBP Safety board and analog output cable at the ferrite core with the longer shaft screw, do not leave the analog output cable on the three ICs (U802, U096 and U097) of the DPU board.

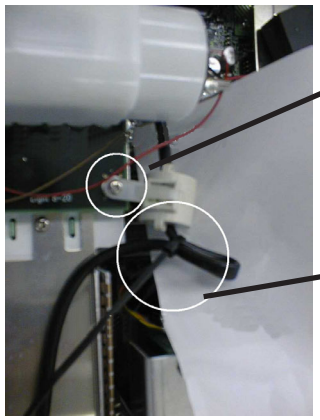


<Wrong>



<Correct>

If the analog output cable is long and it has been left on the three ICs, bind the cable with a cable binder as shown below so that the cable is not left on the three ICs of the DPU board.



The longer shaft screw secures the NIBP Safety board and ferrite core which holds the analog output cable.

The unnecessary part of the analog output cable is bound by a cable binder.

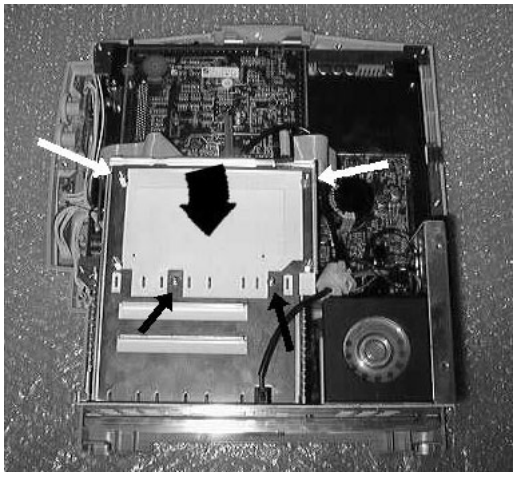
Removing the Motherboard, NIBP Measure Board

Perform the following procedure after the "Removing the NIBP Safety Board" procedure.

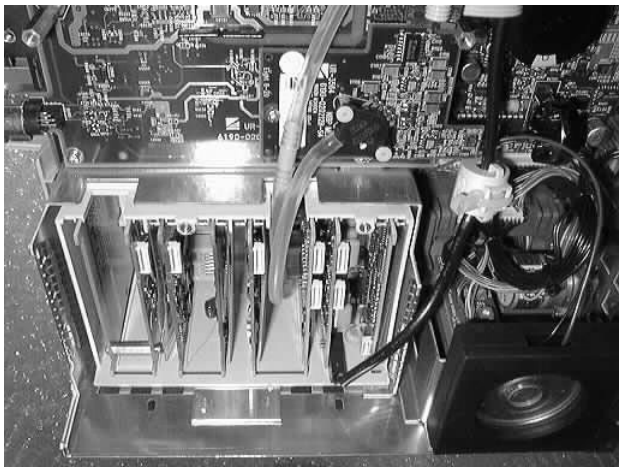
1. Remove the 2 screws and 2 spacer bolts on the motherboard holder as shown below. Slightly tilt the upper part (marked with a thick arrow in the picture) of the motherboard holder and slowly remove it and its insulation sheet to expose the motherboard.

CAUTION

If the motherboard holder or insulation sheet is damaged or the insulation sheet has a hole, it must be replaced with a new one.



2. Slightly tilt the upper part of the motherboard and disconnect the cable connecting to the DPU board from the CNJ701 socket on the motherboard. Slowly remove the motherboard to expose the analog boards and NIBP Measure board.

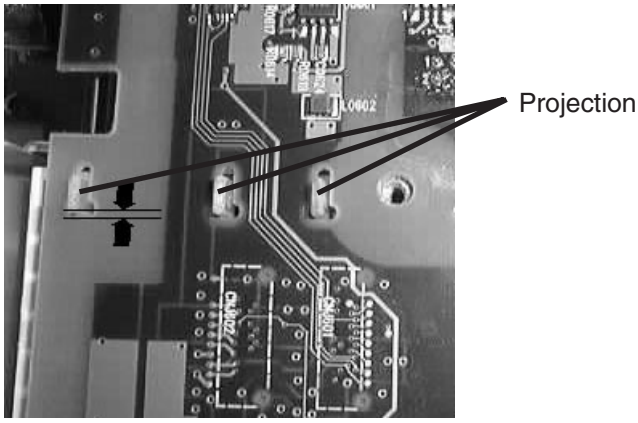


<From the left: MP4, MP3, MP2, MP1, SpO_2, ECG RESP3, ECG RESP2, ECG RESP1 boards>

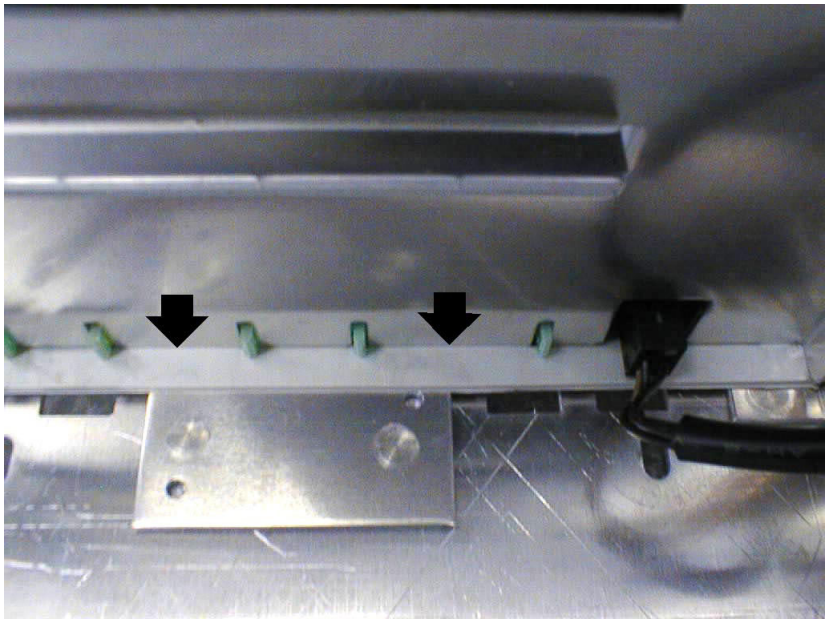
3. Disconnect the air tube from the NIBP Measure board and remove the screw which secures the NIBP Measure board to the DPU board. Remove the NIBP Measure board from the DPU board.

NOTE in Assembling the Instrument

- **To assemble the motherboard and all the analog boards, align the projection bottom edge of each analog board with the bottom edge of the inverted T shape holes on the motherboard (as shown below) so that both side connectors on each analog board and the motherboard can correctly catch each other. Then, depress the area of the connectors, i.e. CNJ601, CNJ602, CNJ401, CNJ301 to 305.**



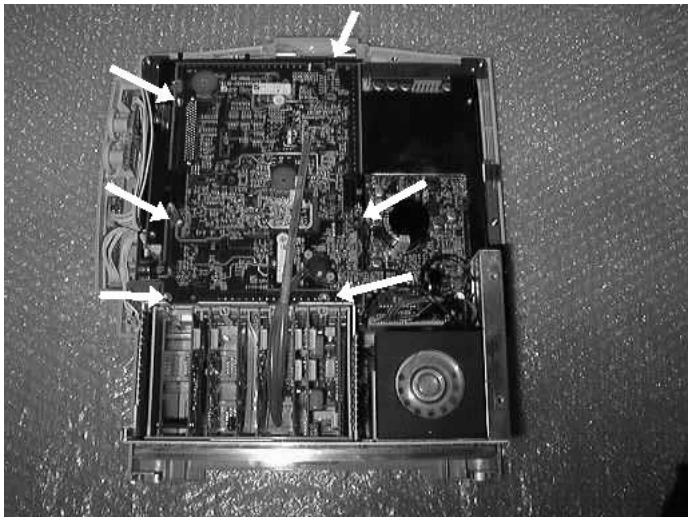
- **Tilt the motherboard holder so that the bottom edge of the motherboard holder can be inserted into the groove of the lower front enclosure. Keep the insertion and lay the motherboard holder on the motherboard.**



Removing the DPU Board

Perform the following procedure after the “Removing the Motherboard, NIBP Measure Board” procedure.

1. Remove the 4 screws and 2 spacer bolts from the DPU board as shown below.



2. Disconnect the analog output cable between the DPU board and ECG RESP2 board from the CNJ013 socket on the DPU board.

3. Remove the DPU board from the DPU board holder.

NOTE in Assembling the Instrument (for BSM-4102A/4112A/ 4104A/4114A)

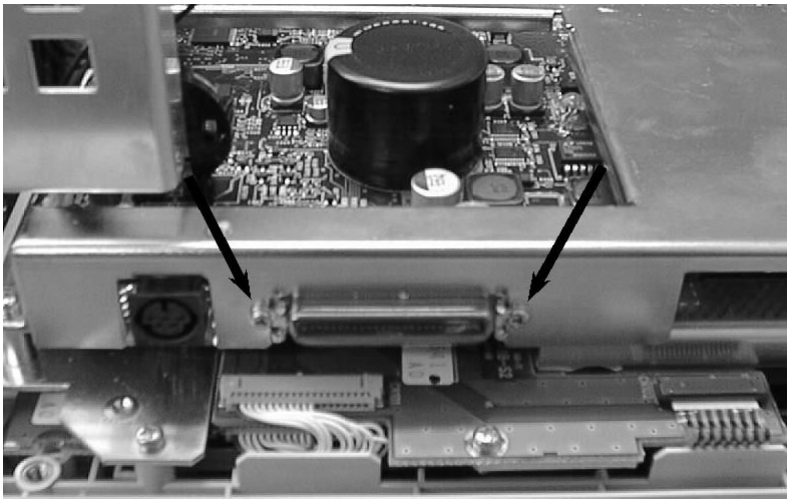
When replacing the DPU board with a new one, check the No. 4 bit switch setting of the SW801 DIP switch on the new DPU board as shown below. The setting depends on the Nellcor SpO_2 module installed in the instrument.

- **No. 4: ON (for MP506 Nellcor SpO_2 module)**
- **No. 4: OFF (for MP304 Nellcor SpO_2 module)**

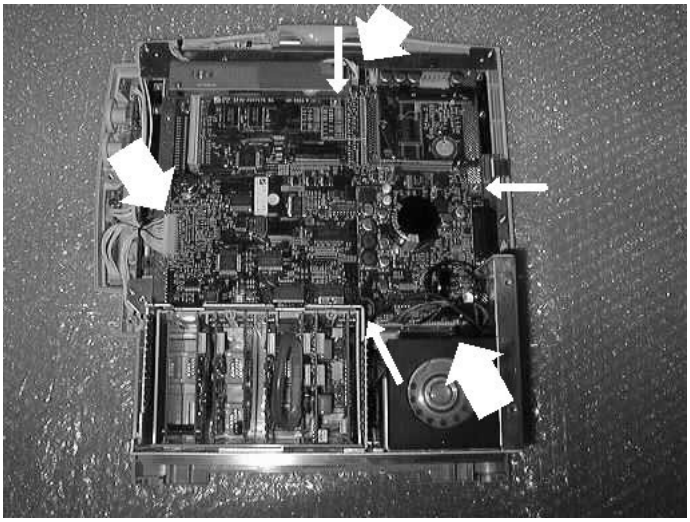
Removing the MAIN Board

Perform the following procedure after the “Removing the DPU Board” procedure.

1. Remove the 2 small screws (PS2.6 x 8) which secure the AUX socket of the MAIN board to the DPU board holder. Remove the 4 screws which secure the DPU board holder and remove it.



2. Disconnect the 6 cables from the CN103, CN108, CN006 and CN121 to CN123 sockets on the MAIN board. Remove the 4 screws which secure the MAIN board and remove it.



NOTE

When the MAIN board is replaced with a new one, set the DIP switch (SW001) on the new MAIN board as follows:
Recorder built-in type (BSM-4101/4102/4103/4104): Set Bit 3 to off.
No recorder type (BSM-4111/4112/4113/4114): Set Bit 3 to on.

Removing the Analog Boards

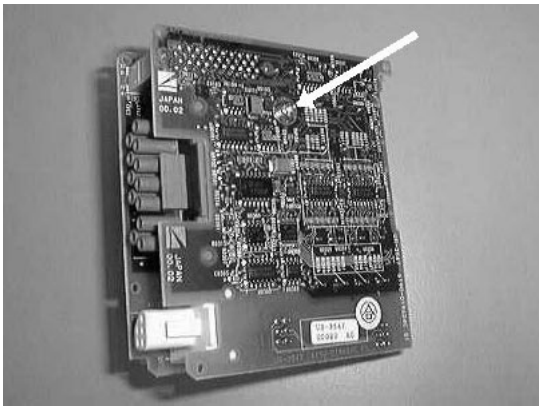
Perform the following procedure after the “Removing the Motherboard, NIBP Measure Board” procedure step 2.

The analog boards are coupled as shown below.

- ECG RESP1 and ECG RESP2 boards
- ECG RESP3 and SpO_2 boards
- MP1 and MP2 boards
- MP3 and MP4 boards

1. Remove the coupled boards from the lower chassis.

2. Remove the pan head screw which combines the two boards as shown below.

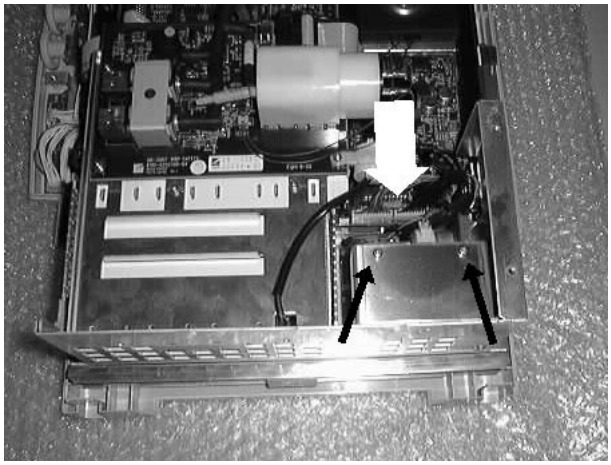


3. Separate the two boards.

Removing the Recorder Unit

Perform the following procedure after the “Opening the Instrument” procedure.

1. Disconnect the 3 cables between the recorder unit and MAIN board from the CN121 to CN123 sockets on the MAIN board.



2. Remove the 2 screws marked with arrows in the above picture.

3. Place the chassis block face up. Pull the paper magazine of the recorder unit upward and remove it.

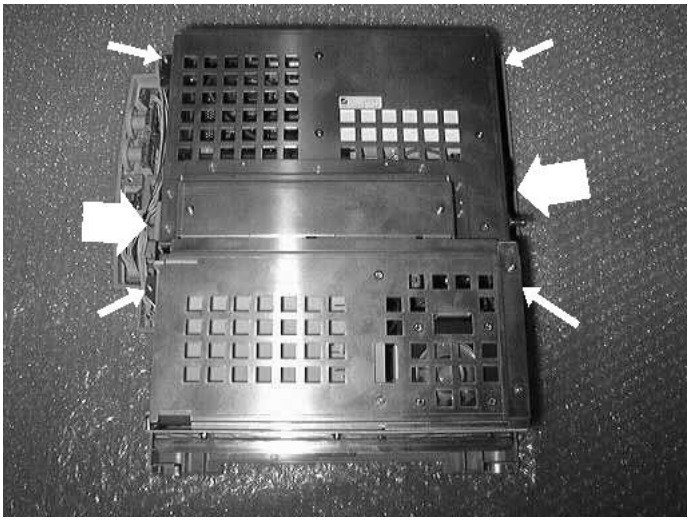
CAUTION in Assembling the Instrument

When attaching the recorder unit to the chassis block, be careful not to pinch or strain the components such as cable and air tube.

Replacing the Touch Screen

Perform the following procedure after the “Opening the Instrument” procedure step 8.

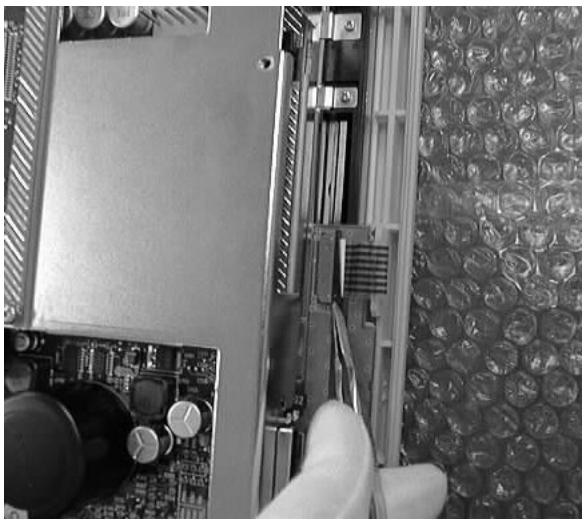
1. Remove the 4 screws which secure the main chassis to the upper front enclosure.



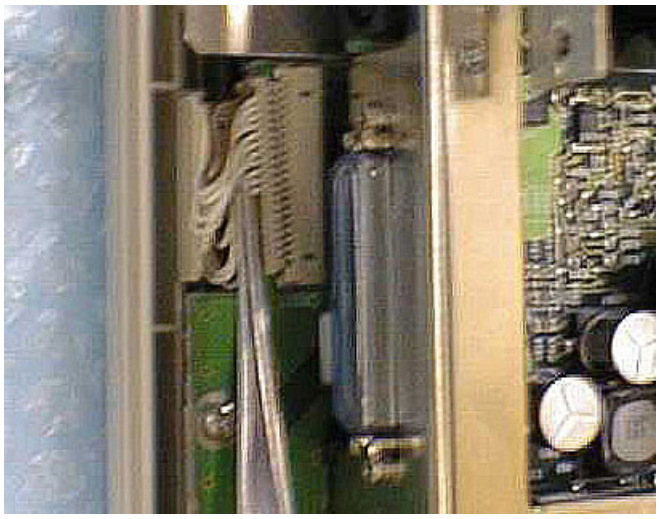
2. Disconnect the touch screen film cable from the connection board.

CAUTION

To disconnect the film cable, pull up the cable stopper of the socket on the MAIN board so that the film cable is set free.



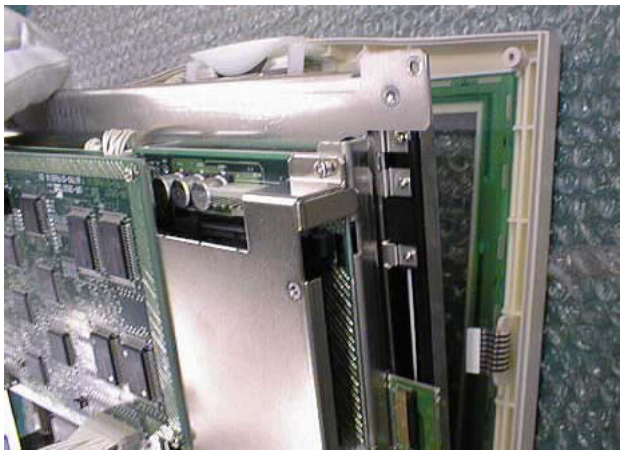
3. Disconnect the cable connecting to the Operation board, Power SW board and alarm indicator board from the MAIN board.



4. Separate the upper front enclosure with the touch screen from the chassis block by slowly setting the chassis block upright.

CAUTION

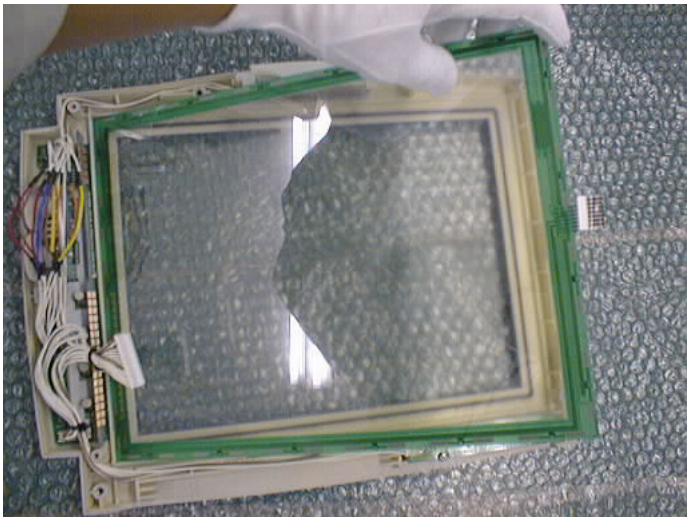
- **Since the touch screen is covered with glass, do not apply excessive mechanical shock such as dropping or pressure to the touch screen.**
- **Pay attention to the sharp glass parts such as the touch screen edges. It can cause cuts and injuries.**
- **If the touch screen is adhered to the LCD unit, carefully peel the touch screen off.**



5. Replace the touch screen and the two long and short packings with new ones. Refer to Section 8 Replaceable Parts List.

CAUTION in Assembling the Instrument

Fit the touch screen onto the original position of the front enclosure. Otherwise, the touch screen will be broken when the chassis block is attached to the front enclosure.



6. Assemble the instrument by reversing the above procedure.

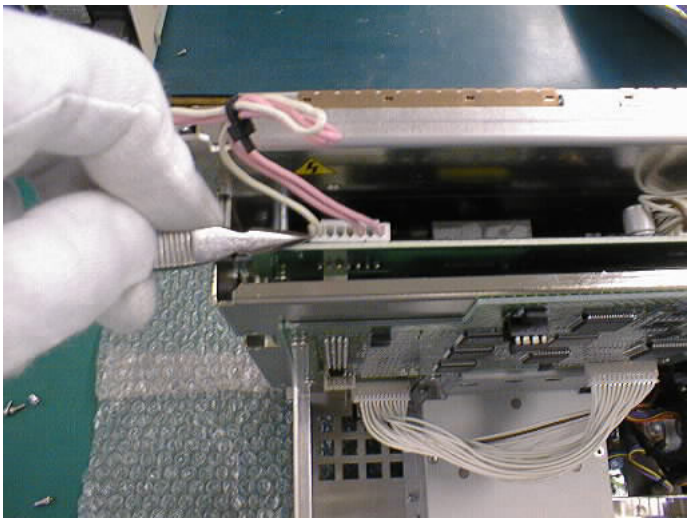
Replacing the Backlight Lamps

Perform the following procedure after the “Replacing the Touch Screen” procedure step 4.

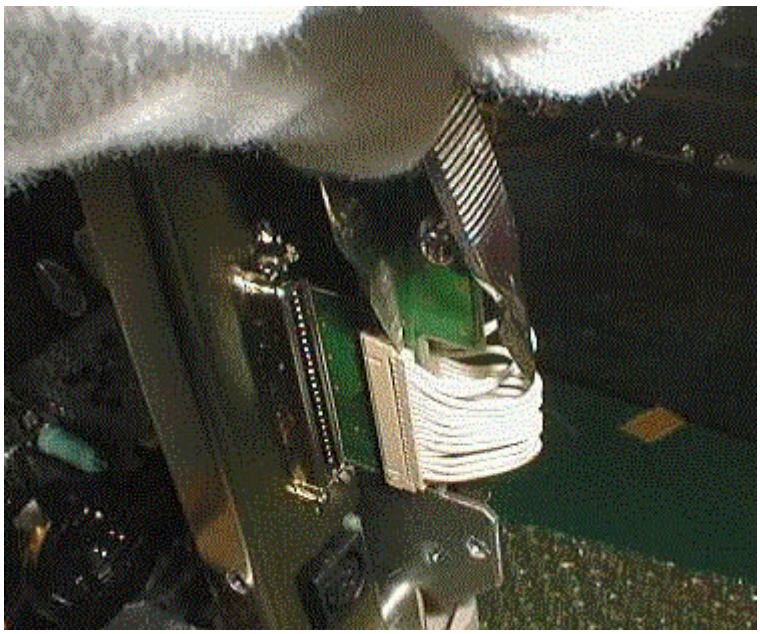
1. Disconnect the cable connecting to the backlight lamps of the LCD unit from the inverter board as shown below.

CAUTION

Be careful not to strain the cable.



2. Disconnect the cable connecting to the LCD unit from the Connection board as shown below.



3. Place the chassis block face up on the table. Remove the 4 screws from the LCD unit as shown below and separate the LCD unit from the chassis block.

CAUTION

- **Since the LCD unit is covered with glass, do not apply a mechanical shock such as dropping or pressure to the LCD unit.**
- **Before placing the LCD unit face down on the table, check that the table is covered with a clean, soft and smooth material to avoid making the screen dirty or damaging the screen.**

4. Place the LCD unit face down on the table covered with a clean, soft and smooth material.

5. Replace the backlight lamps with new ones as follows.

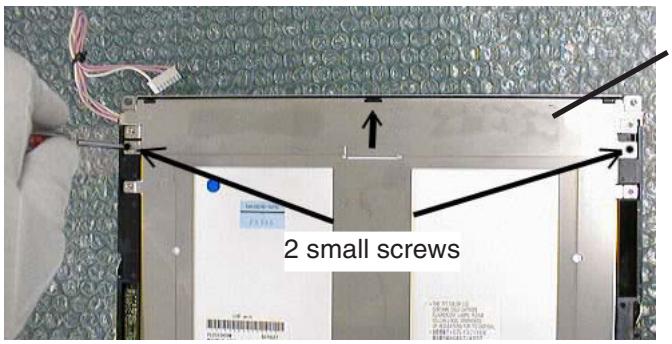
CAUTION

- **Handle the backlight lamp cover carefully because the edges may be sharp and can hurt you.**
- **When removing the 2 old backlight lamps from the holder, use a small tip tool such as small flat-blade screwdriver and carefully insert it between the lamp and holder at both ends. Be careful because the lamp can be easily broken.**
- **Since the lamp is covered with glass, do not apply a mechanical shock such as dropping or pressure to the lamp. If the lamp has a small crack, the gas composition in the lamp will gradually change and the lamp may deteriorate too much in a short period.**
- **Check that the cable between the inverter board and lamps is not damaged. If the cable has even slight damage, it may break the vinyl of the wire and short circuit may occur because a high voltage is output for the lamps through the cable.**

- **Carefully handle the edges of the backlight lamp and cover because their edges are sharp and can cause cuts and injuries.**
- **Discard used backlight lamps (fluorescent tubes) according to your local laws.**

For monitors with revision number before CA

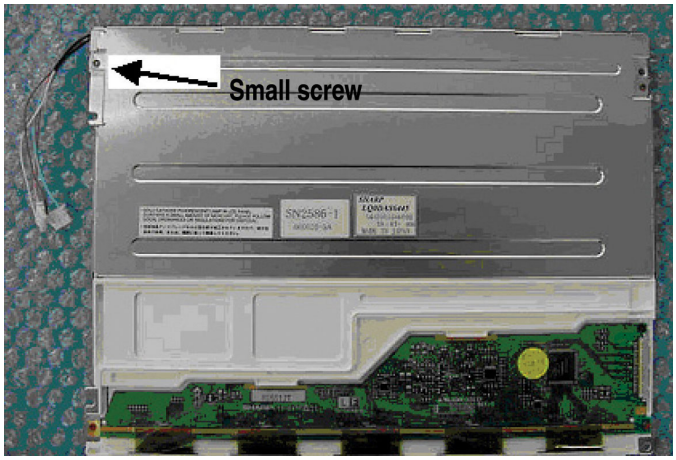
i) Remove the 2 small screws which secure the backlight lamp cover. Slide it outward. 2 backlight lamps are in the holder of the LCD unit.



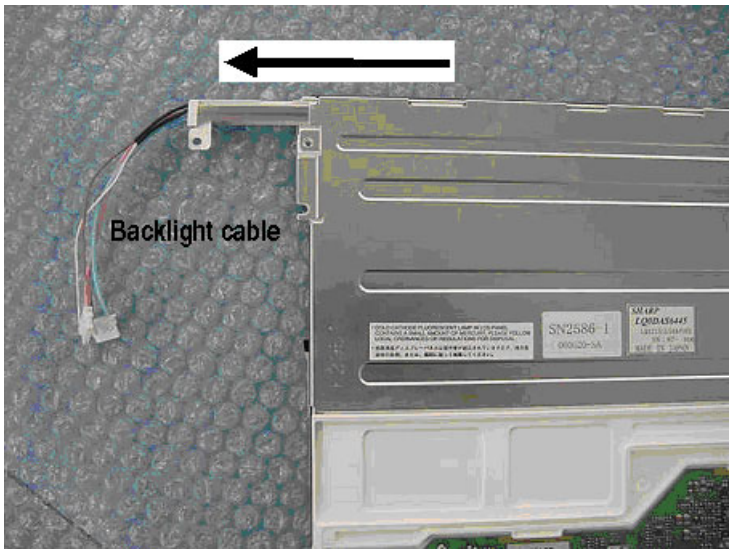
ii) Replace the 2 backlight lamps with new ones.

For monitors with revision number CA or later

i) Place the LCD unit face down on the table covered with a clean, soft and smooth material. Remove the small screw which secure the backlight lamp cover to the LCD unit. Two backlight lamps are in the holder of the LCD unit.



ii) Pull out the backlight lamp by pulling the backlight cable in the direction of the arrow. Replace the 2 backlight lamps with new ones.



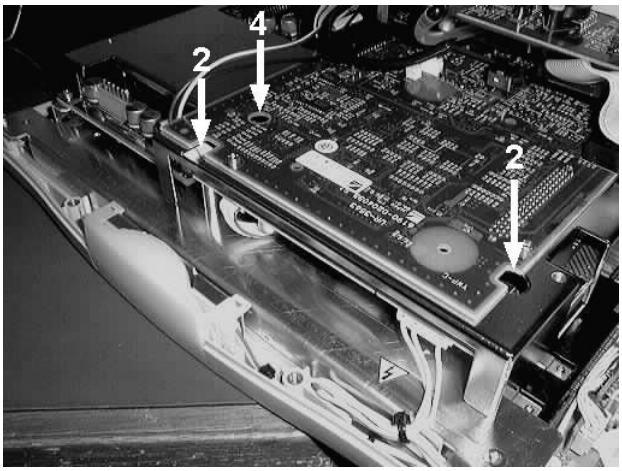
7. Carefully assemble the instrument by reversing the above procedure.

Installing the Options

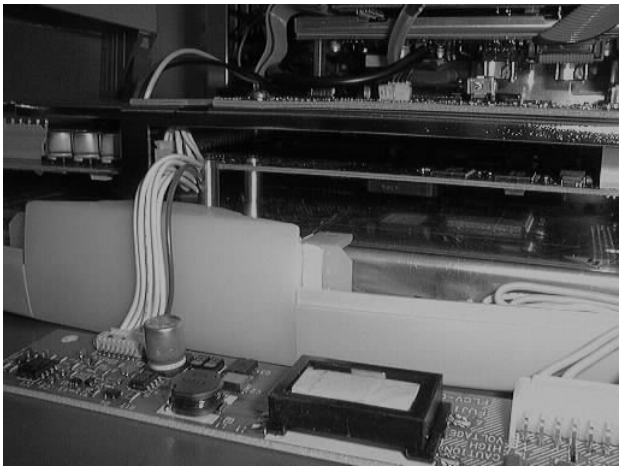
Installing QM-421P Flash Disk Card into the Slot on the MAIN Board

Perform the following procedure after the "Opening the Instrument" procedure.

1. Remove the 2 screws (marked with arrow 2 in the following picture) which secure the inverter board.



2. Pull out the inverter board and put it beside the alarm indicator.



3. Remove the screw (marked with arrow 4 in the step 1 picture) which secure the MAIN board. This screw prevents disconnection of the card.

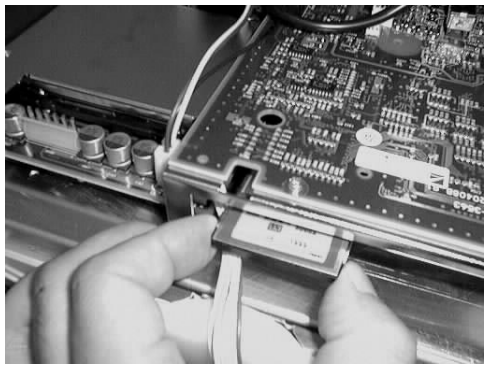
CAUTION

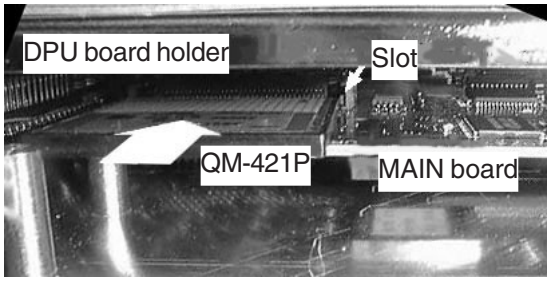
- **Since a high voltage, approximately 600 to 800 V AC, is applied to the cable between the inverter board and LCD unit, you may have an electrical shock if you touch the inverter board within a few minutes after the power is turned off. Wait 5 minutes or more to touch the inverter board after the power is turned off.**
- **Do not scratch or damage the inverter cable with the edge of the chassis or tools.**

4. Insert the card into the card slot on the MAIN board.

CAUTION

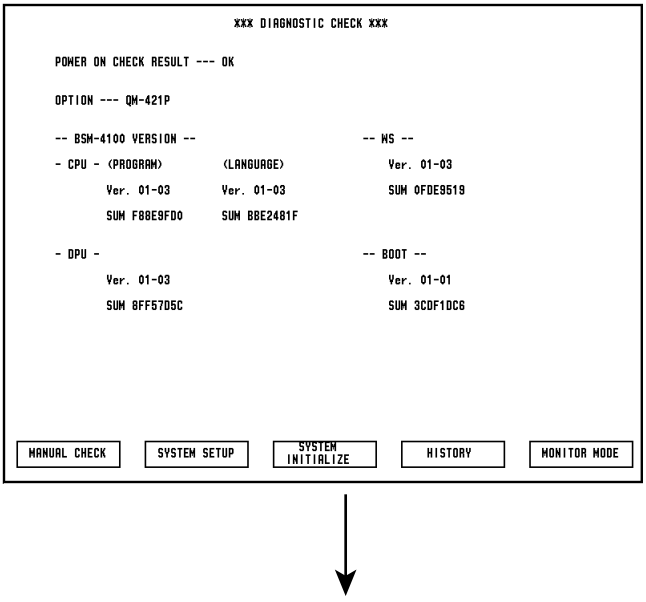
The slot is hard to see. To correctly install the card into the slot, keep the card parallel to the slot while slowly inserting it. Otherwise, pin(s) of the slot may be bent or broken.

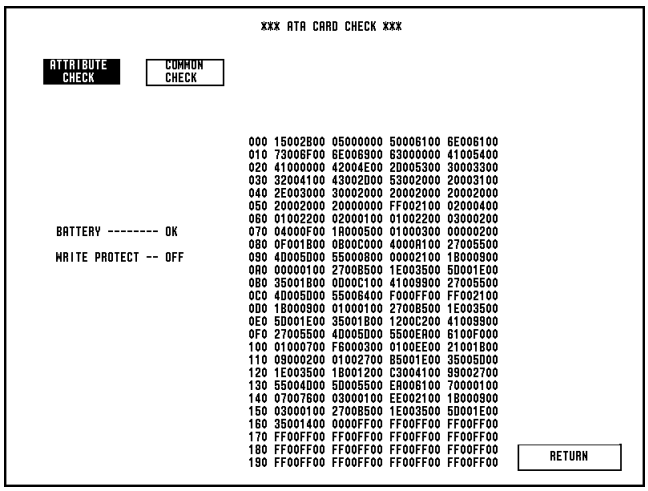


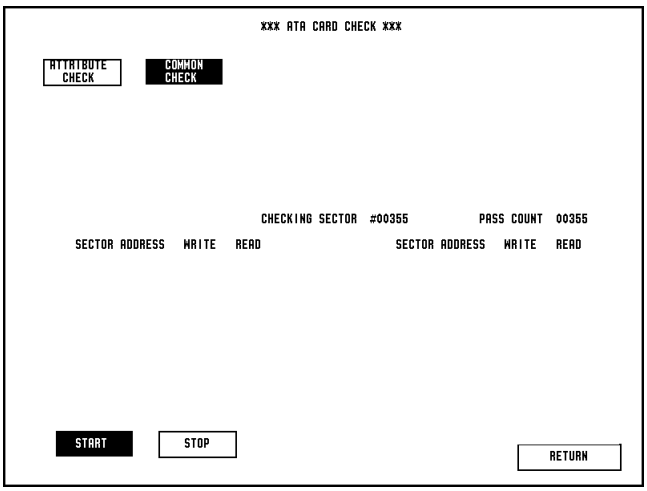


5. Carefully assemble the instrument by reversing the above procedure.

6. Perform the ATA CARD check in the manual check to check the card function. Refer to the Section 3 Diagnostic Check.




xxx ATA CARD CHECK xxx
ATTRIBUTE CHECK
COMMON CHECK
000 15002B00 05000000 50006100 6E006100
010 73006F00 6E006900 63000000 41005400
020 41000000 42004E00 2D005300 30003300
030 32004100 43002D00 53002000 20003100
040 2E003000 30002000 20002000 20002000
050 20002000 20000000 FF002100 02000400
060 01002200 02000100 01002200 03000200
070 04000F00 1R000500 01000300 00000200
080 0F001B00 0B00C000 4000A100 27005500
090 4D005D00 55000B00 00002100 1B000900
0R0 00000100 2700B500 1E003500 5D001E00
0B0 35001B00 0D00C100 41009900 27005500
0C0 4D005D00 55006400 F000FF00 FF002100
0D0 1B000900 01000100 2700B500 1E003500
0E0 5D001E00 35001B00 1200C200 41009900
0F0 27005500 4D005D00 5500EA00 6100F000
100 01000700 F8000300 0100EE00 21001B00
110 09000200 01002700 B5001E00 35005D00
120 1E003500 1B001200 C3004100 99002700
130 55004D00 5D005500 ER006100 70000100
140 07007B00 03000100 EE002100 1B000900
150 03000100 2700B500 1E003500 5D001E00
160 35001400 0000FF00 FF00FF00 FF00FF00
170 FF00FF00 FF00FF00 FF00FF00 FF00FF00
180 FF00FF00 FF00FF00 FF00FF00 FF00FF00
190 FF00FF00 FF00FF00 FF00FF00 FF00FF00
BATTERY -------- OK
WRITE PROTECT -- OFF
RETURN


xxx ATA CARD CHECK xxx
ATTRIBUTE CHECK
COMMON CHECK
CHECKING SECTOR #00355
PASS COUNT 00355
SECTOR ADDRESS WRITE READ
SECTOR ADDRESS WRITE READ
START
STOP
RETURN

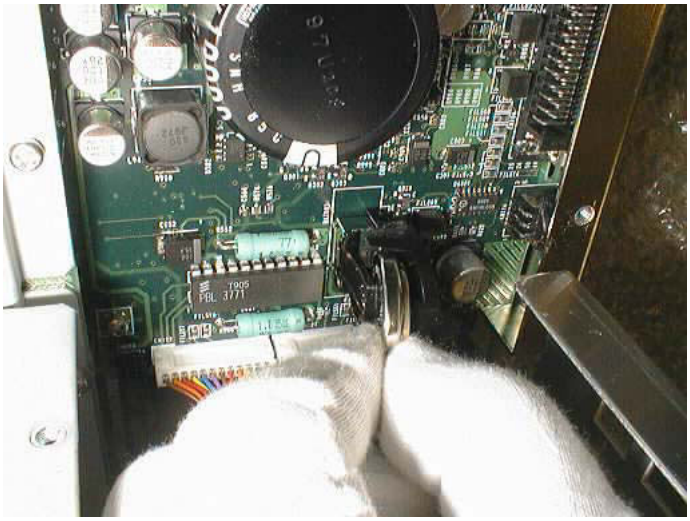
Replacing the Lithium Battery

Perform the following procedure after the “Removing the DPU Board” procedure.

CAUTION

- **Use a glove to handle the new lithium battery. If you touch it with your bare hand, it may cause an increase of resistance at the battery terminals and shorten the lifetime.**
- **Never charge, short-circuit, disassemble, deform, heat, or throw the battery into fire. This may cause overheating, explosion, or fire.**
- **Before disposing of the battery, cover it with insulation tape to prevent short circuit between the positive and negative terminals. Otherwise, the battery may heat, explode or burn if the battery is disposed of with other batteries or electrically conductive materials.**
- **Discard used batteries according to your local laws.**

1. Replace the lithium battery on the MAIN board with a new one as shown below.



2. After the battery replacement, check the continuity between the battery terminal and receptacle terminal with a multimeter or digital voltmeter.

Section 6 Maintenance

To Be Replaced Periodically 6.1
Required Tools 6.1
Measuring and Test Equipment 6.2
YS-073P8 Board/Unit Maintenance Kit 6.3
- Composition 6.3
- Connection 6.3
- Connection Diagram 6.5

Maintenance Check Items and Schedule 6.6
- External 6.6
- Input Conditions 6.6
- Operation 6.7
- Display 6.7
- Recorder 6.7
- Vital Sign Parameters 6.8
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- Data Backup 6.9
- Safety 6.9
- Others 6.10

Maintenance Check Sheet 6.11

To Be Replaced Periodically

We recommend the periodic replacement of the following components according to the expected life span.

NK Code No.	Description	Expected Life Span
585876	Backlight assembly for LCD unit of the monitors with revision number before CA	Approx. 25,000 hours or 2 years and 10 months or more of continuous operation
709699	Backlight assembly for LCD unit of the monitors with revision number CA or later	Approx. 50,000 hours or 5 years and 9 months or more of continuous operation
481809	Lithium battery for clock operation backup	Approx. 6 years or more
6114-053114C	Platen roller	Approx. 6 years or more
107002	Retainer ring	Must be replaced with a new one when the platen roller is replaced.
445074	Thermal array head	Approx. 250 stacks or more of the recording paper
445109C	Paper drive motor	Approx. 6000 stacks or more of the recording paper

Required Tools

- Long-bladed Phillips screwdriver (insulated)
- Long-bladed flat screwdriver (insulated)
- Anti-static bench mat connected to appropriate ground
- Anti-static wrist strap connected to appropriate ground
- 6 mm standard hex (Allen) wrench or hexagon key
- 3 mm hex socket driver
- Tweezers
- Nippers
- Cable ties

Measuring and Test Equipment

To repair, check, or adjust the instrument, the following measuring and test equipment or equipment with similar function and performance is required.

Digital Voltmeter

A digital tester with at least 3-1/2 digits LCD display that can measure voltage, current, and resistance.

Cathode-ray Oscilloscope

An oscilloscope with a bandwidth of more than 1 MHz and a sensitivity of more than 10 mV/cm.

Function Generator

A function generator with a range of 1 Hz to at least 1 kHz with 1% or better frequency accuracy.

AX-800P Vital Sign Simulator

The simulator outputs simulated waveforms, i.e. ECG waveform, respiration curve, 4 blood pressure waveforms, 2 temperature fixed values, and cardiac output curve.

548631A Adapter Cable

Although the simulator has the connection cable for previous bedside monitors such as BSM-2100/3101/7000/8300/8502/8800, the new bedside monitors such as BSM-1100/2301/4100/9510 and BSS-9800 require this adapter cable instead of the previous bedside monitor connection cable.

YS-077P1 NIBP Dummy Cuff

A 700 ml container that is needed for some NIBP diagnostic check items.

YS-077P2 NIBP Dummy Cuff

A 250 ml container that is needed for some NIBP diagnostic check items.

YS-073P8 Board/Unit Maintenance Kit

Designed for the maintenance of the boards and units for BSM-4100 series and WEP-4204/4208.

YS-073P8 Board/Unit Maintenance Kit

Composition

The kit consists of the following.

- Extension boards: 11 pcs.
- Extension cables: 11 pcs.
- 80-pin connectors: 2 pcs.

Connection

Refer to Connection Diagram as shown below.

- Extension boards

DEBUG1: Connects the MAIN board and DPU board. The two 80-pin connectors of this kit let you align the DPU board either vertical or horizontal to the MAIN board. The desired connector (vertical or horizontal) must be soldered on the DEBUG1 board. The connector has a triangle mark which must be matched with pin 1A of CN102 on the DEBUG1 board.

DEBUG2: Connects the MAIN board to the DEBUG3 board with the CNA2 and CNA3 cables.

DEBUG3: Connects the Connection board to the DEBUG2 board with the CNA2 and CNA3 cables.

EXT1: Connects the Operation, Power SW and alarm indicator boards to the MAIN board with the CNA6 cable.

EXT2: Connects the recorder unit and speaker to the MAIN board with the CNA7, CNA8 and CNA10 cables. The EXT2 board has +5 V DC input and ground terminals and two resistors for the recorder unit adjustment so that the output from the photo transistor of the recorder unit can be adjusted with a digital voltmeter when the recorder unit, EXT2 board and +5 V DC supply are connected. Refer to Section 7 ADJUSTMENT. Set the jumper setting as follows:

Short circuit of pins 1 and 2: Enables to directly receive +5 V DC from a DC power supply.

Short circuit of pins 3 and 4: Enables to receive +5 V DC from the power supply unit when the MAIN board is connected to the EXT2 board.

EXT3: Connects the motherboard to the EXT6 board with the CNA9 cable. The EXT3 board has two connectors each for the motherboard and cable.

EXT4: Connects the ECG RESP2 or ECG RESP3 board to the EXT5 board with the CNA5 cable.

EXT5: Connects the ECG RESP1 or MP1 board to the EXT4 board with the CNA5 cable.

EXT6: Connect the ECG RESP2 or ECG RESP3 board to the EXT3 with the CNA9 cable. The EXT6 board has two connectors each for the analog board and cable.

EXT7: Connects the SpO_2, MP2 or MP3 board to the EXT8 board with the

CNA9 cable. The EXT7 board has one connector each for the analog board and cable.

EXT8: Connects the motherboard to the EXT7 board with the CNA9 cable. The EXT8 board has one connector each for the motherboard and cable.

- Extension cables

CNA1 (50 cm long): Extends the distance between the MAIN and Inverter boards.

CNA2 (30 cm long): Extends the distance between the DEBUG2 and DEBUG3 boards. The cable is used for touch screen signals.

CNA3 (30 cm long): Extends the distance between the DEBUG2 and DEBUG3 boards. The cable is used for the LCD unit display signals.

CNA4 (50 cm long): Extends the distance between the DPU board and motherboard.

CNA5 (20 cm long): Extends the distance between the EXT4 and EXT5 boards.

CNA6 (50 cm long): Extends the distance between the MAIN and EXT1 boards.

CNA7 (50 cm long): Extends the distance between the MAIN and EXT2 boards. The cable is used for the paper drive motor control signals and photo sensor signals.

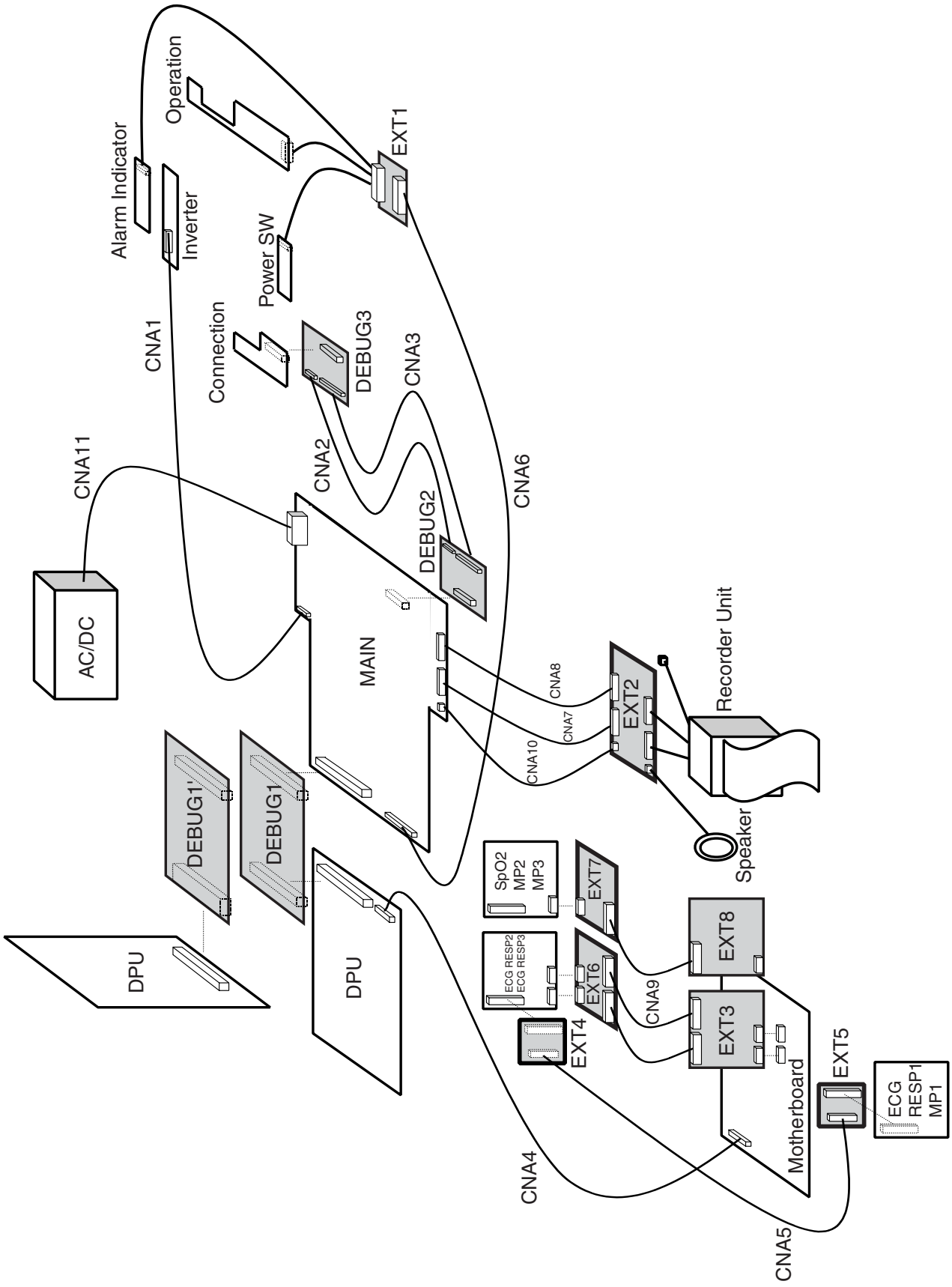
CNA8 (50 cm long): Extends the distance between the MAIN and EXT2 boards. The cable is used for the thermal array head control signals.

CNA9 (20 cm long): Extends the distance between the EXT3 and EXT6 boards and between the EXT8 and EXT7 boards.

CNA10 (50 cm long): Extends the distance between the MAIN and EXT2 boards. The cable is used for the speaker.

CNA11 (70 cm long): Extends the distance between the MAIN board and power supply unit.

Connection Diagram



Maintenance Check Items and Schedule

Perform this maintenance check once every six months.

A maintenance check sheet is provided at the end of this section. Make a copy of this check sheet before using it. The check items are grouped as follows:

- External
- Input conditions
- Operation
- Display
- Recorder
- Vital sign parameters
- Power
- Data backup
- Safety
- Others

Following are the procedures for each check item.

External

Item	Check Procedure	Action
Dirt, stain or crack	Check that there is no dirt, stain and crack on the instrument.	If the instrument is dirty, clean it with a cloth moistened with water, neutral soap or alcohol. If the instrument has stain or crack, remove it or replace the stained or cracked part with a new one.
Damaged switch or key top cover	Check that there are no physically damaged switches and key top covers.	If any switch or key top cover is damaged, replace it with a new one.

Input Conditions

Item	Check Procedure	Action
Contact between input socket on the instrument and connector of connection cord	Check that there is good contact between the input socket and connector of the connection cord.	Remove the cause if there is a poor contact between them.
Input socket on the instrument or connector of connection cord	Visually check that there is no damaged input socket and connector.	If the input socket or connector is damaged, replace it with a new one.
Electrode lead wire or connection cord	Visually check that there is no damage of the lead wire and connection cord.	If the electrode lead wire or connection cord has a damage, replace it with a new one.

Operation

Item	Check Procedure	Action
Key function on the operation panel	Check that the function of each key on the control panel works correctly.	Remove the cause if the key function is wrong.
Touch screen key function	Check that the function of each key on the screen works correctly.	Remove the cause if the key function is wrong.

Display

Item	Check Procedure	Action
Crack, scratch or dirt	Check that there is no crack, scratch or dirt on the touch screen.	If there is a crack or scratch on the screen, replace it with a new one. If the screen is dirty, clean it with a soft cloth moistened with water.
Display control settings	Check that the control settings such as brightness work correctly.	If one of the control settings has no function, remove the cause.
Minimum brightness control	Check that the waveforms and data do not disappear when the brightness is set to minimum on the screen.	Remove the cause if the waveforms or data disappear from the screen.
CRTC check	Check that there is no error on the screen when performing the CRTC checks on the Manual Check Menu screen.	Remove the cause if an error occurs.

Recorder

Item	Check Procedure	Action
Waveform and character data on paper	Check that the waveform and character data on the paper are clear.	If the waveform or character data is not clear, clean the thermal array head. Refer to the operator's manual.
Recording paper	Check that Nihon Kohden recording paper is used.	If unspecified paper is used, replace it with Nihon Kohden specified paper.
Paper drive check	Check that the paper moves at a preset paper speed without snaking.	Remove the cause if the paper moves abnormally.
Abnormal sound	Check that the motor and gears do not generate abnormal sound.	Remove the cause if there is abnormal sound.
Mark detection	Check that the mark detection works correctly.	Remove the cause if the mark detection does not work.
Recorder check in WS Check mode	Check that there is no error on the paper when performing the recorder check in the WS Check mode. Refer to Section 3.	Replace the MAIN board or other component with a new one according to the WS Check Mode section.
Printed date and time check	Check that the correct date and time are printed on the paper.	Remove the cause if the date and time is wrong or not printed.

Vital Sign Parameters

Item	Check Procedure	Action
Waveform and numeric data	Check that ECG, respiration, blood pressure waveforms, their parameters and temperature data are displayed correctly and QRS synchronous sound is generated when connecting AX-800P vital sign simulator to the instrument.	If there is anything wrong, check the connection between the AX-800P and instrument and remove the cause.
SpO_2 and NIBP	Check that the displays of SpO_2 and NIBP parameters are acceptable when applying the SpO_2 probe and NIBP cuff to a healthy person or yourself.	If there is a big difference, check the connection between the healthy person and instrument and remove the cause.
NIBP check	Check that there is no error on the screen when performing the NIBP checks on the Manual Check Menu screen.	Remove the cause if an error occurs.
Multi-parameter socket function	Check that the connection cord is recognized and the related parameter is displayed when connecting the connection cord to the socket.	If the socket has no function, plug the connection cord into the other multi-parameter sockets and check which one is wrong, connection cord or instrument.
Zero balance of IBP	Check that the blood pressure transducer is zero balanced when connecting the transducer to the instrument through the IBP connection cord and pressing " ZERO" key on the screen.	If the transducer is still imbalanced after zeroing, connect the transducer to the other multi-parameter sockets and check which one is wrong, transducer or instrument.
Alarm function	Check that the alarm mark appears on the screen, the alarm indicator works, and the alarm sounds when an alarm occurs.	If there is anything wrong, check the corresponding part.
Transducer	Check that the specified sensor and transducer are used.	If the unspecified sensor or transducer is used, replace it with the specified one.

Power

Item	Check Procedure	Action
Power cord	Check that the power cord does not have any damage, poor continuity, heat, sound or smell while bending each part of the power cord.	If the power cord has a malfunction, replace it with a new one.
Ground lead	Check that the ground lead has no damage and no poor continuity while bending each part of the ground lead.	If the ground lead has a malfunction, replace it with a new one.
Fuse	Check that the specified fuses are used and not blown.	If the fuse is blown, replace it with a new one after removing the cause.
Power indicator check	Check that the power indicators such as the power lamp, AC power lamp and battery power lamp works properly.	Remove the cause if there is anything wrong.

Data Backup

Item	Check Procedure	Action
System Setup data backup	Check that the System Setup data is saved for a long time after the power is turned off.	If the System Setup data disappears within 30 minutes after the power off, replace the super capacitor on the MAIN board with a new one.
Clock function backup	Check that the clock function works correctly when the power is turned on.	If the clock stops while the instrument is turned off, replace the lithium battery on the MAIN board with a new one.

Safety

Perform the following patient safety check after repairing the instrument.

Item		Check Procedure	Action
Protective earth impedance (refer to IEC 60601-1-18.(f))		Check that the impedance between the protective earth contact and any accessible metal part does not exceed 0.1 Ω.	Remove the cause if the impedance exceeds 0.1 Ω
Earth leakage current (refer to IEC 60601-1 19)		Check that the earth leakage current does not exceed 0.5 mArms under normal condition and 1.0 mArms under each single fault condition.	Remove the cause if the earth leakage current exceeds one of the maximum values.
Enclosure leakage current (refer to IEC 60601-1 19)		Check that the enclosure leakage current does not exceed 0.1 mArms under normal condition and 0.5 mArms under each single fault condition.	Remove the cause if the enclosure leakage current exceeds one of the maximum values.
Patient leakage current (refer to IEC 60601-1 19)	Patient leakage current	Check that the patient leakage current to type CF or defibrillation-proof type CF applied part does not exceed 0.01 mArms under normal condition and 0.05 mArms under each single fault condition.	Remove the cause if the patient leakage current exceeds one of the maximum values.
		Check that the patient leakage current to type BF or defibrillation-proof type BF applied part does not exceed 0.1 mArms under normal condition and 0.5 mArms under each single fault condition.	
	Patient leakage current (mains voltage on the applied part)	Check that the patient leakage current to type CF or defibrillation-proof type CF applied part does not exceed 0.05 mArms under each single fault condition.	
		Check that the patient leakage current to type BF or defibrillation-proof type BF applied part does not exceed 5 mArms under each single fault condition.	
Dielectric strength (refer to IEC 60601-1 20)		Check that the instrument has the following withstand voltages. • A-a1: 1500 V AC for one minute • A-f: 1500 V AC for one minute • B-a: 4000 V AC for one minute • B-d: 1500 V AC for one minute	Remove the cause if the instrument does not have all the withstand voltages.

Others

Item	Check Procedure	Action
Line voltage	Check that the line voltage is within the range of nominal voltage ±10%.	Use only the line voltage within the correct range.
Connection to other equipment	Check that the instrument is correctly connected to other equipment according to the operator's manual.	If there is a wrong connection, connect the equipment to the instrument correctly according to the operator's manual.
Vibration or resonant sound	Check that the instrument has no abnormal vibration or resonant sound.	Remove the cause of abnormal vibration or resonant sound.
Screws	Check that there are no loose screws.	If any screw is loose, tighten it.
Option check	Check that there is no error on the screen when performing the optional card checks such as ATA Card Check and Network Card Check on the Manual Check Menu screen.	Remove the cause if an error occurs.
Installation condition check	Check that the instrument is installed in a suitable location according to the operator's manual.	If the conditions are not suitable, improve them.

Maintenance Check Sheet

(Refer to the Maintenance section of the service manual for details.)

Customer: _____ Customer Address: _____

Service Personnel: _____ Service Company: _____

Instrument Name: _____ Instrument Model: _____

Instrument Serial Number: _____ Hardware Revision: _____

Software Revision: _____

External

There is no dirt, stain, and crack on the instrument.	Yes	No
There are no damaged switches and key top covers.	Yes	No
The warning and caution labels are clearly readable.	Yes	No

Input Conditions

There is good contact between the input socket on the instrument and connector of the connection cord.	Yes	No
There is no damage on the input socket and connection cord connector.	Yes	No
There is no damage and internal cut on the lead wire and connection cord.	Yes	No

Operation Keys

The function of each key on the operation panel works correctly.	Yes	No
The function of each key on the screen works correctly.	Yes	No

Display

The brightness is correctly adjusted.	Yes	No
There is no distortion on the screen.	Yes	No
Alarm indicator works properly.	Yes	No

Vital Sign Parameters

ECG waveform, heart rate, and QRS synchronous mark are properly displayed with QRS synchronous sound generated.	Yes	No
Respiration waveform and respiration rate are properly displayed.	Yes	No
Plethysmographic pulse waveform and SpO_2 data are properly displayed.	Yes	No
NIBP data (systolic, diastolic and mean blood pressures) are acceptable.	Yes	No
Multi-parameter sockets recognize the respective connection cords and the waveforms and data are properly displayed.	Yes	No
“ALL ZERO” key and multi-parameter key on the screen allow zero balance of the blood pressure transducer.	Yes	No
Alarm functions properly.	Yes	No
Alarm sound works properly.	Yes	No
Specified sensor and transducers are used.	Yes	No

Recorder

Waveforms are clearly recorded on the paper.	Yes	No
Alphanumeric data is clearly recorded on the paper.	Yes	No
Date and time is recorded on the paper.	Yes	No
Specified recording paper is used.	Yes	No

Data Backup

System setup data is saved.	Yes	No
Clock function works properly while the instrument is turned off.	Yes	No

Power

Power cord (and ground lead) are not damaged.	Yes	No
Instrument is firmly grounded to a dedicated grounding terminal.	Yes	No
Fuse is the correct rating.	Yes	No

Safety

Protective earth impedance is less than prescribed limit.	Yes	No
Earth leakage current is less than prescribed limits.	Yes	No
Enclosure leakage current is less than prescribed limits.	Yes	No
Patient leakage current is less than prescribed limits.	Yes	No
Withstand voltages of instrument are prescribed voltage and time limits or more.	Yes	No

Others

Line voltage is within the range of nominal voltage ±10%.	Yes	No
Instrument is correctly connected to other equipment.	Yes	No
All screws are tight.	Yes	No

Section 7 Adjustment

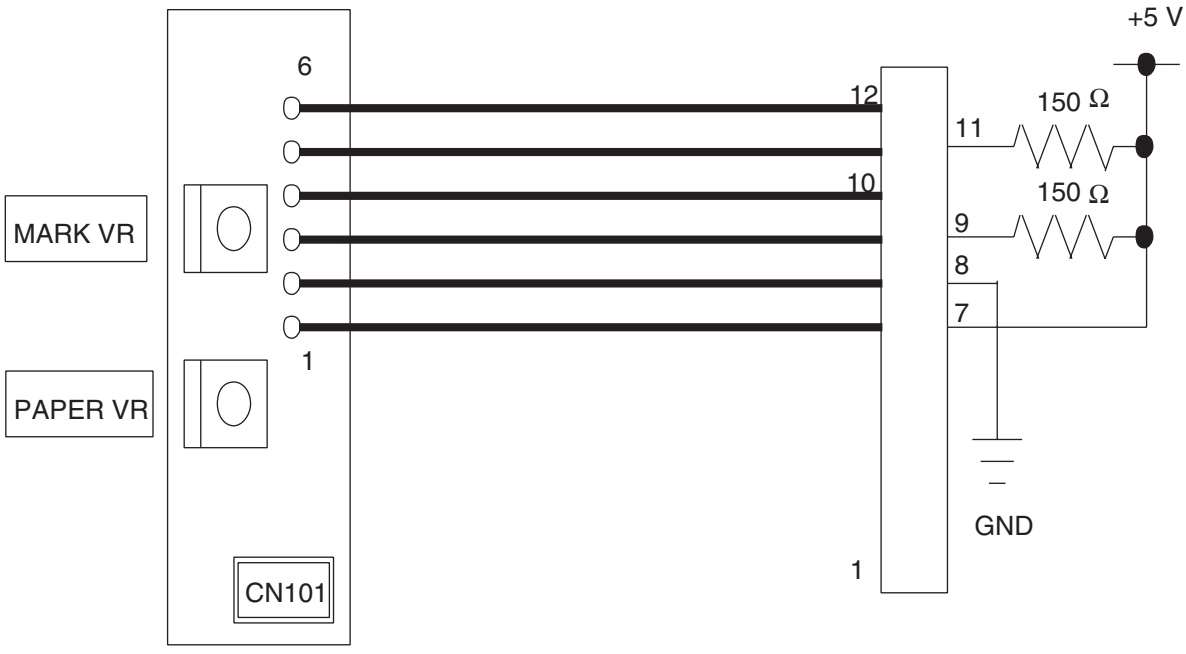
Sensors in the Recorder Unit 7.1
Adjusting the Output Voltages with Digital or Analog Multimeter 7.1
Adjusting the Output Voltages with the YS-073P8 Board/Unit Maintenance Kit and Digital or Analog Multimeter 7.2
Adjusting the Output Voltages with the YS-073P8 Board/Unit Maintenance Kit and Oscilloscope 7.2

Sensors in the Recorder Unit

After you replace the sensor board of the recorder unit with a new one, adjust the paper and mark detection output voltages on the sensor control board as shown below.

Adjusting the Output Voltages with Digital or Analog Multimeter

1. Connect 150 Ω resistors to pins 9 and 11 of the 12-pin connector cable from the sensor control board as shown below.
2. Connect +5 V DC of a +5 V DC power supply to the two resistors and pin 7 of the 12-pin connector as shown below.
3. Connect the ground terminal of the +5 V DC power supply to pin 8 of the 12-pin connector.
4. Set the recording paper inside the paper magazine according to the operator's manual "Loading the Recording Paper" in Section 2 PREPARATIONS.
5. Draw out one page of the recording paper so that the small black square on the corner of the paper is not over the mark detection sensor.
6. Adjust the PAPER VR and MARK VR so that pins 10 (PAPER output) and 12 (MARK output) of the 12-pin connector output a voltage within the range of 3.5 V DC to 4.0 V DC, respectively when the two sensors detect the white part of the paper.

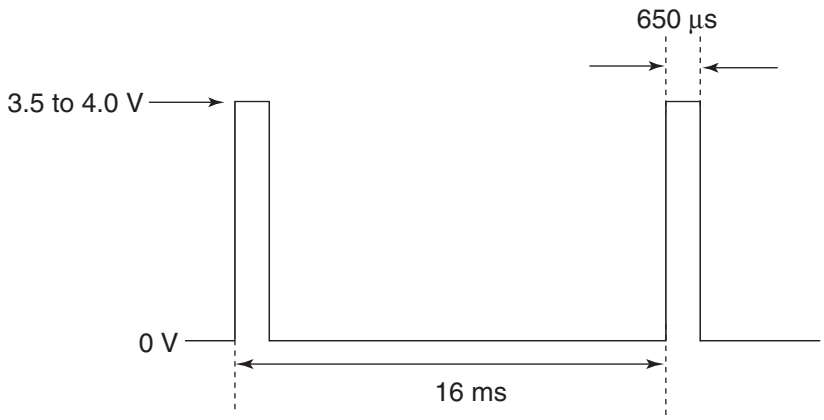


Adjusting the Output Voltages with the YS-073P8 Board/Unit Maintenance Kit and Digital or Analog Multimeter

1. Connect the EXT2 board of the kit to the recorder unit. Refer to "YS-073P8 Board/Unit Maintenance Kit" in Section 6.
2. Short pins 1 and 2 at the jumper setting terminal on the EXT2 board.
3. Connect +5 V DC of a +5 V DC power supply to the +5 V input terminal on the EXT2 board.
4. Connect the ground terminal of the +5 V DC power supply to the ground terminal on the EXT2 board.
5. Set the recording paper inside the paper magazine according to the operator's manual "Loading the Recording Paper" in Section 2 PREPARATIONS.
6. Draw out one page of the recording paper so that the small black square on the corner of the paper is not over the mark detection sensor.
7. Adjust the PAPER VR and MARK VR so that the PAPER and MARK test pins on the EXT2 board output a voltage within the range of 3.5 V DC to 4.0 V DC when the two sensors detect the white part of the paper.

Adjusting the Output Voltages with the YS-073P8 Board/Unit Maintenance Kit and Oscilloscope

1. Connect the EXT2 board between the recorder unit and MAIN board connected to the instrument. Refer to "YS-073P8 Board/Unit Maintenance Kit" in Section 6.
2. Short pins 3 and 4 at the jumper setting terminal on the EXT2 board.
3. Turn on the instrument.
4. Set the recording paper inside the paper magazine according to the operator's manual "Loading the Recording Paper" in Section 2 PREPARATIONS.
5. Draw out one page of the recording paper so that the small black square on the corner of the paper is not over the mark detection sensor.
6. Connect the probe of the oscilloscope to the PAPER or MARK test pin on the EXT2 board.
7. Connect the ground clip of the oscilloscope to the ground pin on the EXT2 board. The following rectangular waveform (16 ms interval) appears on the screen of the oscilloscope.



8. Adjust the PAPER VR and MARK VR so that the PAPER and MARK test pins on the EXT2 board output the rectangular amplitude within the range of 3.5 V DC to 4.0 V DC when the two sensors detect the white part of the paper.

Section 8 Replaceable Parts List

Bedside Monitor BSM-4101/4103/4111/4113 ..... 8.2
Bedside Monitor BSM-4102/4104/4112/4114 (MP304* included) 8.10
Bedside Monitor BSM-4102/4104/4112/4114 (MP506* included) 8.18
RG-921P Recorder Unit 8.26

When ordering parts or accessories from your nearest Nihon Kohden Corporation distributor, please quote the NK code number and part name which are listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs. Always use Nihon Kohden parts and accessories to assure maximum performance from your instrument.

Bedside Monitor BSM-4101/4103/4111/4113

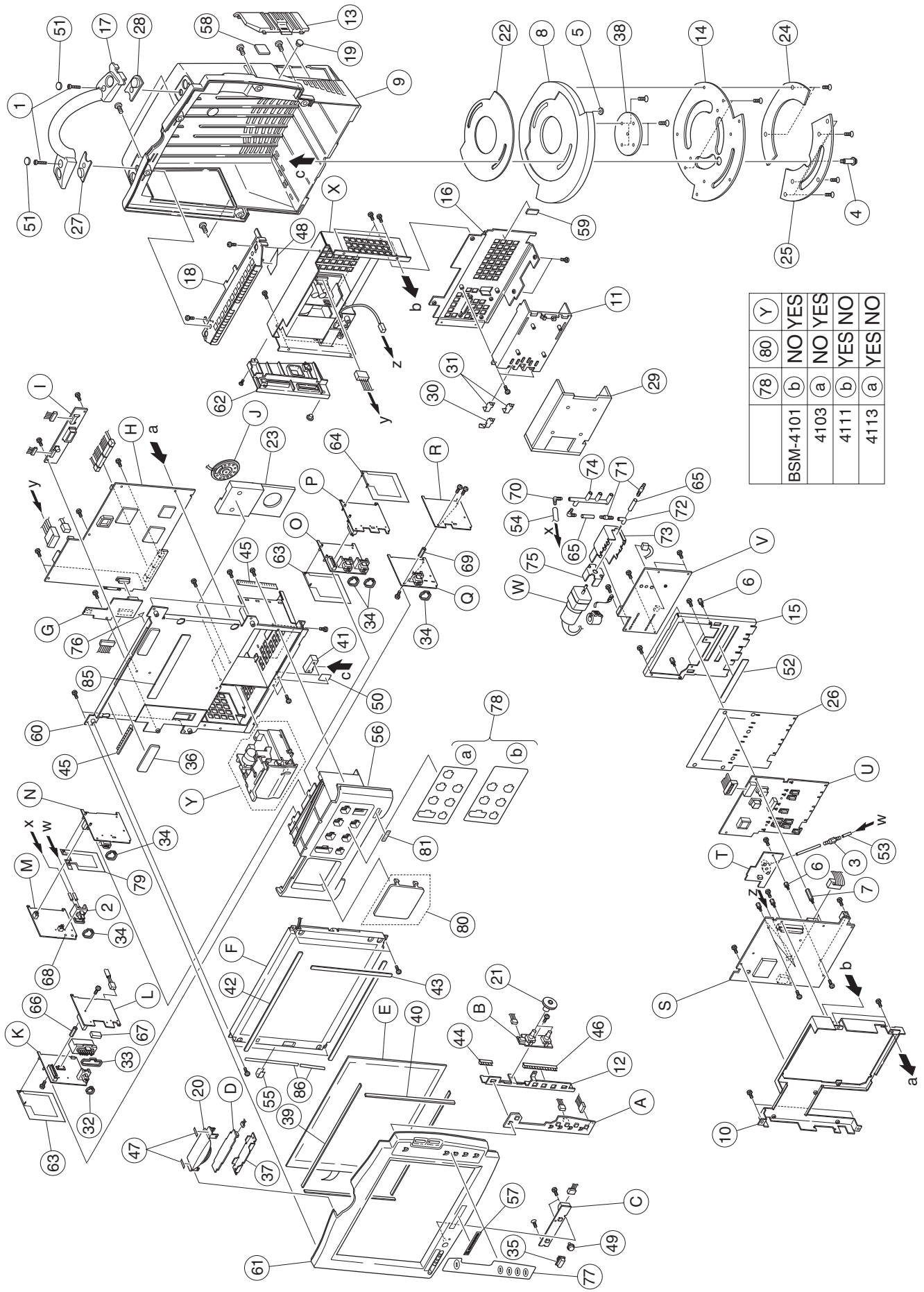
Index	NK Code No.	Qty	Description
1	289848	2	Hexagon socket head bolt
2	515542B	1	NIBP socket
3	531346	1	NIBP air filter
4	577288	1	Collar head screw with spacer
5	579375	1	Washer
6	1114-139714	6	Spacer bolt (7.2 mm long)
7	1114-164116	2	Spacer bolt (27.5 mm long)
8	6111-005618B	1	Swivel base
9	6111-005654B	1	Rear enclosure*1
10	6111-005886C	1	DPU board holder
11	6112-000345B	1	Battery guide enclosure
12	6112-013251E	1	Operation board holder
13	6112-013313B	1	Battery cover
14	6112-013385C	1	Swivel plate
15	6112-013803C	1	Motherboard holder*2
16	6112-013812B	1	Lower rear chassis cover
17	6112-013848B	1	Handle
18	6112-014009A	1	Handle holder base*3
19	6113-029179A	1	ZB-800P socket cover
20	6113-036055A	1	Alarm indicator top cover*4
21	6113-036064A	2	Dial
22	6113-036411A	1	Swivel spacer
23	6113-037125	1	Speaker holder
24	6113-037179A	1	Swivel bottom rubber plate 1
25	6113-037188A	1	Swivel bottom rubber plate 2
26	6113-037419B	1	Motherboard insulation sheet
27	6113-037428B	1	Handle packing (left)
28	6113-037437B	1	Handle packing (right)
29	6113-037794	1	Thermal insulation cover
30	6114-002205A	1	Battery receptacle terminal 1
31	6114-002214	2	Battery receptacle terminal 2
32	6114-073191B	1	ECG/BP OUT socket packing
33	6114-073208A	1	ECG socket packing
34	6114-073217A	5	SpO_2/NIBP/Multi socket packing
35	6114-073556B	1	Power switch top cover
36	6114-074796	2	Heat radiation sheet (for monitors with revision number before CA)
37	6114-105576B	1	Reflector

*1 For the rear enclosure (Index 9) replacement, the battery label (Index 59) must also be replaced with a new one.

*2 For the motherboard holder (Index 15) replacement, the motherboard cushion sponge (Index 52) must also be replaced with a new one.

*3 For the handle holder base (Index 18) replacement, the inverter board insulation sheet (Index 48) must also be replaced with a new one.

*4 For the alarm indicator top cover (Index 20) replacement, the two alarm indicator packings (Index 47) must also be replaced with new ones.



	78	80	Y
BSM-4101	b	NO	YES
4103	a	NO	YES
4111	b	YES	NO
4113	a	YES	NO

Index	NK Code No.	Qty	Description
38	6114-106557	1	Swivel stopper
39	6114-106619A	2	Touch screen packing (long)*5
40	6114-106628A	2	Touch screen packing (short)*5
41	6114-106691B	1	Main chassis bottom holder
42	6114-106789	2	Dust protector (long)*6
43	6114-106798	1	Dust protector (short)*6
44	6114-107208	1	Earth spring with 2 holes (for monitors with revision number before CA)
45	6114-107217	2	Earth spring with 4 holes (for monitors with revision number before CA)
46	6114-107226	1	Earth spring with 5 holes (for monitors with revision number before CA)
47	6114-107877	2	Alarm indicator packing*4
48	6114-107886	1	Inverter board insulation sheet*3
49	6114-108181	1	Record key top cover
50	6114-108261	1	Insulation sheet for main chassis bottom holder*7
51	6114-109438A	2	Rubber cap
52	6114-110098	1	Motherboard cushion sponge*2
53	6114-110204	1	Silicon tube (115 mm long)
54	6114-110213	1	Silicon tube (150 mm long)
55	6114-112657	1	Shielding tape*6 (for monitors with revision number before CA)
56	6122-004714A	1	Lower front enclosure
57	6124-025928	1	Nihon Kohden logo sheet
58	6124-031743	1	ZB-800P label
59	6124-032332	1	Battery label*1
60	6141-000781B	1	Main chassis*7 (for monitors with revision number before CA)
or	6141-900166A	1	Main chassis 4100N assy*7 (for monitors with revision number CA or later)
61	6141-000807A	1	Upper front enclosure
62	6142-002233A	1	Side panel
63	6143-010249A	2	Shield sheet (left)
64	6143-010258A	1	Shield sheet (right)
65	6114-110222	2	Silicon tube (20 mm long)
66	292042	1	Spacer (20 mm long)
67	6114-108938	1	Spacer
68	6114-073975	1	Hall element
69	128113	1	Spacer (18 mm long)
70	531337	2	Plastic elbow tube
71	531355	2	Check valve
72	1114-221509	1	Elbow tube

*1 For the rear enclosure (Index 9) replacement, the battery label (Index 59) must also be replaced with a new one.

*2 For the motherboard holder (Index 15) replacement, the motherboard cushion sponge (Index 52) must also be replaced with a new one.

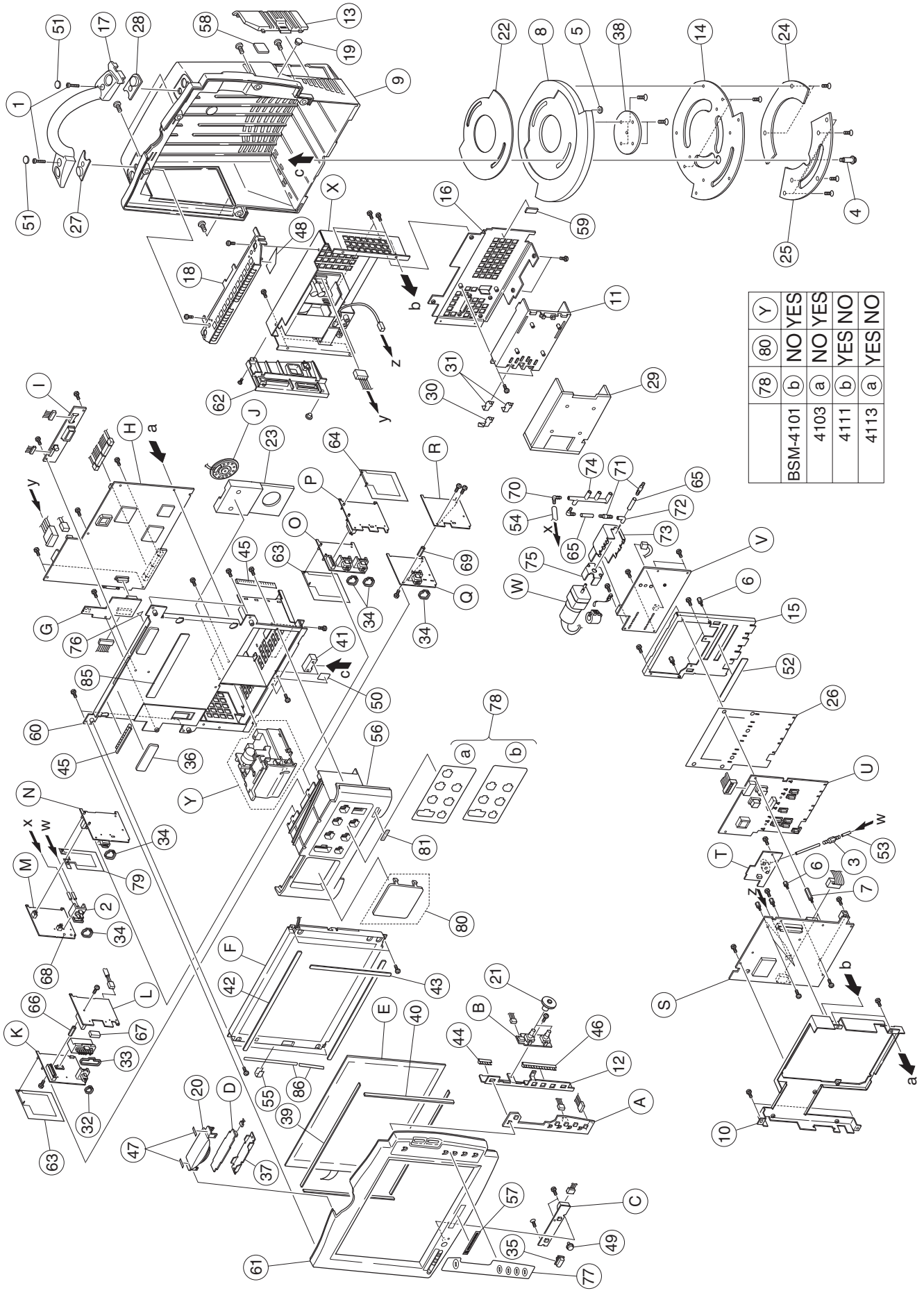
*3 For the handle holder base (Index 18) replacement, the inverter board insulation sheet (Index 48) must also be replaced with a new one.

*4 For the alarm indicator top cover (Index 20) replacement, the two alarm indicator packings (Index 47) must also be replaced with new ones.

*5 For the touch screen (Index E) replacement, the two long and short packings must also be replaced with new ones.

*6 For the LCD unit (Index F) replacement, the two long and short dust protectors (Index 42, 43 and 86) and shielding tape (Index 55) must also be replaced with new ones.

*7 For the main chassis (Index 60) replacement, the insulation sheet for main chassis bottom holder (Index 50) must also be replaced with a new one.

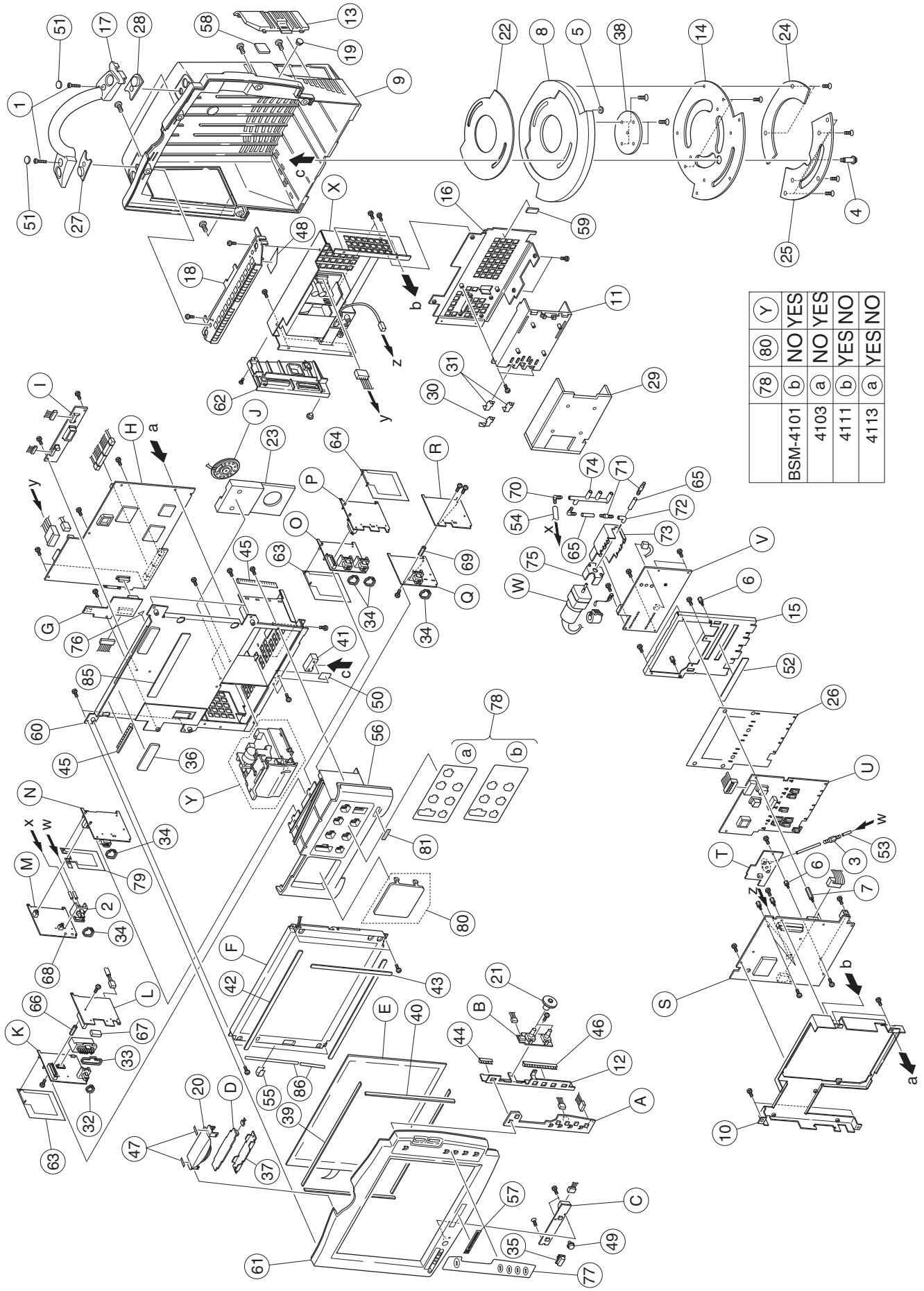

(Y)
80
78
BSM-4101 b NO YES
4103 a NO YES
4111 b YES NO
4113 a YES NO

Index	NK Code No.	Qty	Description
73	6113-023844D	1	Pump holder
74	6113-037713A	1	Manifold tube
75	6114-073618	1	Sponge
76	1124-037173B	1	High voltage warning label
77	6122-004625A	1	Operation panel sheet
78-a	6123-011918A	1	Input panel for BSM-4103/4113
78-b	6123-011927A	1	Input panel for BSM-4101/4111
79	6143-010267A	1	Shield sheet for BSM-41x1/41x3
80	6112-013857B	1	Recorder blank panel
81	————	1	BSM-4101A model number label
	6124-031984	1	BSM-4101J model number label
	6124-031583	1	BSM-4101K model number label
	6124-031565	1	BSM-4103A model number label
	6124-032002	1	BSM-4103J model number label
	6124-031609	1	BSM-4103K model number label
	————	1	BSM-4111A model number label
	6124-032029	1	BSM-4111J model number label
	6124-031707	1	BSM-4111K model number label
	6124-031681	1	BSM-4113A model number label
	6124-032047	1	BSM-4113J model number label
	6124-031725	1	BSM-4113Kmodel number label
85	915627	1	Gasket (for monitors with revision number CA or later)
86	6114-134909	2	Dust protector (2-S)*6
A	UR-35431	1	Operation board
B	UR-3544	1	Function dial board
C	UR-35421	1	Power SW board
D	576556A	1	Alarm indicator board
E	575833A	1	Touch screen*5
F	575815A	1	LCD unit*6 (for monitors with revision number before CA)
or	916359	1	LCD unit*6 (for monitors with revision number CA or later)
G	UR-3541	1	Connection board
H	UR-3586	1	MAIN board
I	575824A	1	Inverter board
J	575842	1	Speaker
K	UR-3546*7	1	ECG RESP1 board
L	UR-3547*7	1	ECG RESP2 board
M	UR-3548*7	1	ECG RESP3 board
N	UR-3561	1	NK SpO_2 board
O	UR-3557	1	MP1 board
P	UR-3558	1	MP2 board

*5 For the touch screen (Index E) replacement, the two long and short packings must also be replaced with new ones.

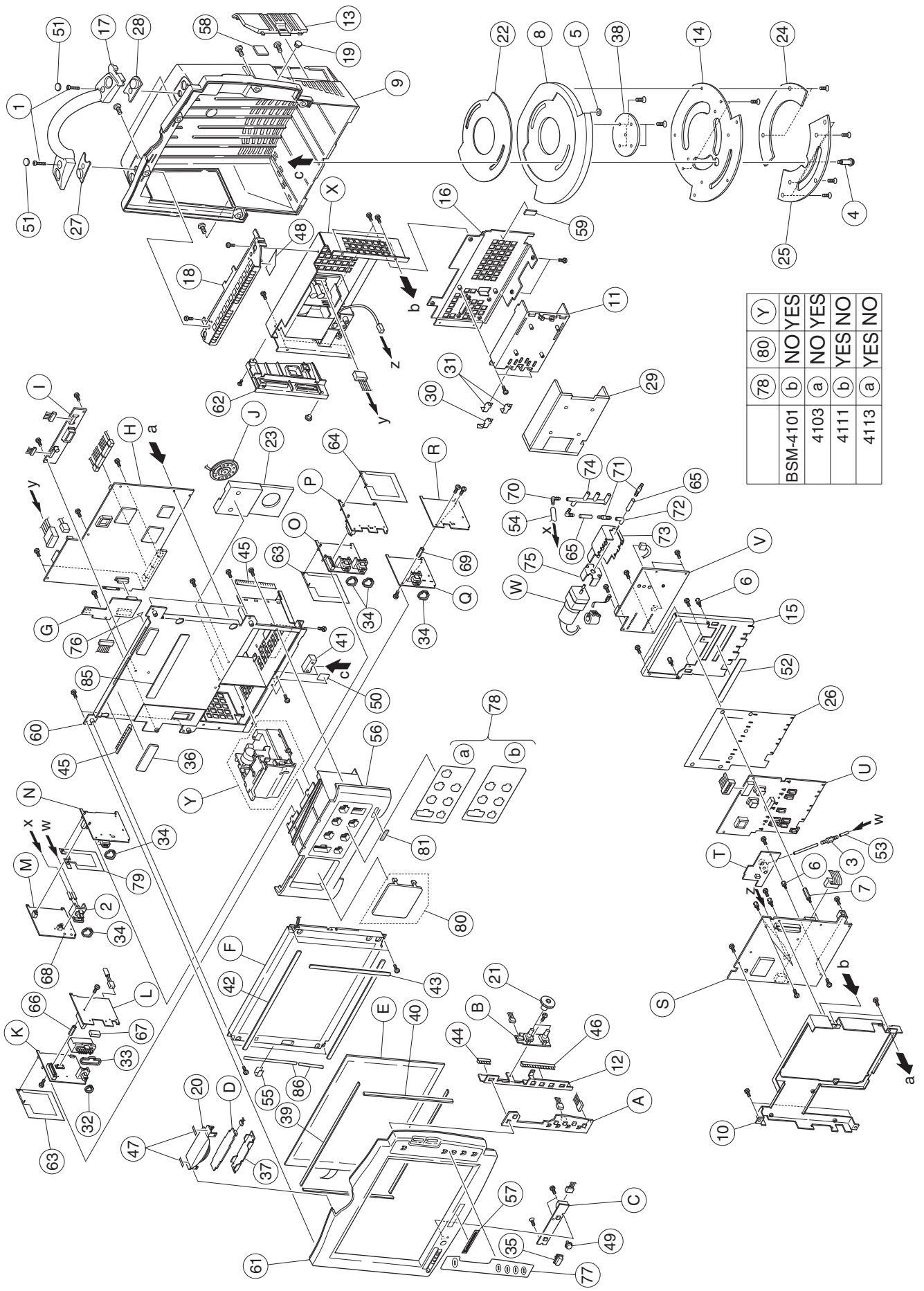
*6 For the LCD unit (Index F) replacement, the two long and short dust protectors (Index 42, 43 and 86) and shielding tape (Index 55) must also be replaced with new ones.

*7 ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.


(Y) (80) (78)
BSM-4101 NO (b)
4103 NO (a)
4111 YES (b)
4113 YES (a)
YES
YES
NO
NO

Index	NK Code No.	Qty	Description
Q	UR-3559	1	MP3 board for BSM-4103/4113
	UR-35591	1	MP3 dummy board for BSM-4101/4111
R	6190-020774C	1	MP4 board
S	UR-3563	1	DPU board
T	UR-3564	1	NIBP Measure board
U	UR-3566*	1	Motherboard
V	UR-3567	1	NIBP Safety board
W	532149	1	NIBP pump
X	SC-039R	1	Power supply block
	Consists of the following components.		
	551734	1	Equipotential ground terminal
	6112-013402	1	Power supply unit insulator cover
	6114-107886	1	Inverter board insulation sheet
	6124-009937A	1	Equipotential terminal mark
	6142-002456	1	Upper rear chassis cover
	6142-002233A	1	Side panel
	550013A	1	Power supply unit
	580676	1	AC inlet socket with fuse holder
Y	RG-921P	1	Recorder unit

* ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.



	78	80	Y
BSM-4101	b	NO	YES
4103	a	NO	YES
4111	b	YES	NO
4113	a	YES	NO

Bedside Monitor BSM-4102/4104/4112/4114 (MP304* included)

*** When the MP304 is built in the instrument, there is no indication of "NELLCOR OxiMax". Refer to page 1.20 "On the BSM-4102/4104/4112/4114 Monitors".**

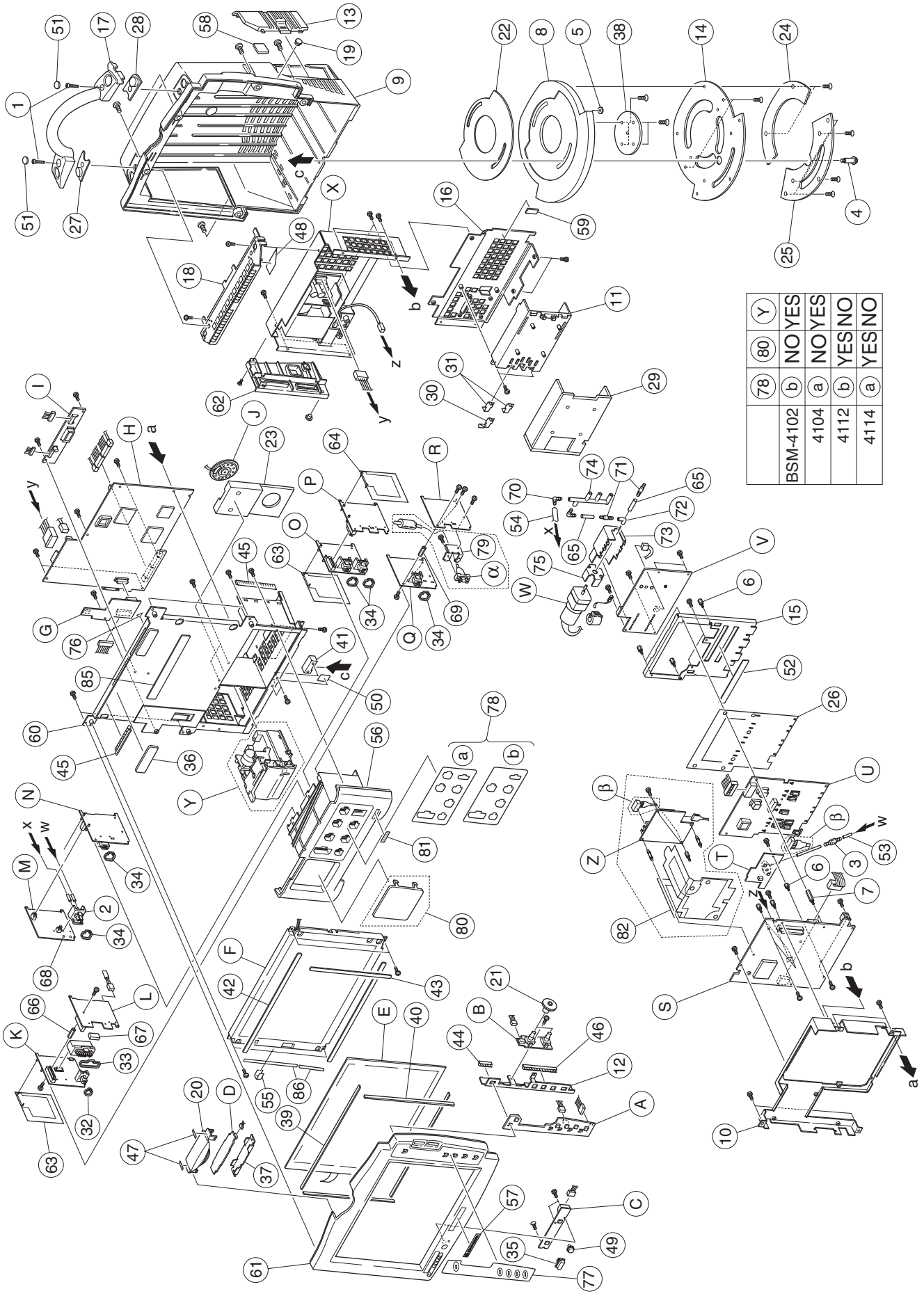
Index	NK Code No.	Qty	Description
1	289848	2	Hexagon socket head bolt
2	515542B	1	NIBP socket
3	531346	1	NIBP air filter
4	577288	1	Collar head screw with spacer
5	579375	1	Washer
6	1114-139714	7	Spacer bolt (7.2 mm long)
7	1114-164116	2	Spacer bolt (27.5 mm long)
8	6111-005618B	1	Swivel base
9	6111-005654B	1	Rear enclosure*1
10	6111-005886C	1	DPU board holder
11	6112-000345B	1	Battery guide enclosure
12	6112-013251E	1	Operation board holder
13	6112-013313B	1	Battery cover
14	6112-013385C	1	Swivel plate
15	6112-013803C	1	Motherboard holder*2
16	6112-013812B	1	Lower rear chassis cover
17	6112-013848B	1	Handle
18	6112-014009A	1	Handle holder base*3
19	6113-029179A	1	ZB-800P socket cover
20	6113-036055A	1	Alarm indicator top cover*4
21	6113-036064A	2	Dial
22	6113-036411A	1	Swivel spacer
23	6113-037125	1	Speaker holder
24	6113-037179A	1	Swivel bottom rubber plate 1
25	6113-037188A	1	Swivel bottom rubber plate 2
26	6113-037419B	1	Motherboard insulation sheet
27	6113-037428B	1	Handle packing (left)
28	6113-037437B	1	Handle packing (right)
29	6113-037794	1	Thermal insulation cover
30	6114-002205A	1	Battery receptacle terminal 1
31	6114-002214	2	Battery receptacle terminal 2
32	6114-073191B	1	ECG/BP OUT socket packing
33	6114-073208A	1	ECG socket packing
34	6114-073217A	5	SpO_2/NIBP/Multi socket packing
35	6114-073556B	1	Power switch top cover
36	6114-074796	2	Heat radiation sheet (for monitors with revision number before CA)
37	6114-105576B	1	Reflector

*1 For the rear enclosure (Index 9) replacement, the battery label (Index 59) must also be replaced with a new one.

*2 For the motherboard holder (Index 15) replacement, the motherboard cushion sponge (Index 52) must also be replaced with a new one.

*3 For the handle holder base (Index 18) replacement, the inverter board insulation sheet (Index 48) must also be replaced with a new one.

*4 For the alarm indicator top cover (Index 20) replacement, the two alarm indicator packings (Index 47) must also be replaced with new ones.


(Y) (80) (78)
BSM-4102 (b) NO YES
4104 (a) NO YES
4112 (b) YES NO
4114 (a) YES NO

Index	NK Code No.	Qty	Description
38	6114-106557	1	Swivel stopper
39	6114-106619A	2	Touch screen packing (long)*5
40	6114-106628A	2	Touch screen packing (short)*5
41	6114-106691B	1	Main chassis bottom holder
42	6114-106789	2	Dust protector (long)*6
43	6114-106798	1	Dust protector (short)*6
44	6114-107208	1	Earth spring with 2 holes (for monitors with revision number before CA)
45	6114-107217	2	Earth spring with 4 holes (for monitors with revision number before CA)
46	6114-107226	1	Earth spring with 5 holes (for monitors with revision number before CA)
47	6114-107877	2	Alarm indicator packing*4
48	6114-107886	1	Inverter board insulation sheet*3
49	6114-108181	1	Record key top cover
50	6114-108261	1	Insulation sheet for main chassis bottom holder*7
51	6114-109438A	2	Rubber cap
52	6114-110098	1	Motherboard cushion sponge*2
53	6114-110204	1	Silicon tube (115 mm long)
54	6114-110213	1	Silicon tube (150 mm long)
55	6114-112657	1	Shielding tape*6 (for monitors with revision number before CA)
56	6122-004714A	1	Lower front enclosure
57	6124-025928	1	Nihon Kohden logo sheet
58	6124-031743	1	ZB-800P label
59	6124-032332	1	Battery label*1
60	6141-000781B	1	Main chassis*7 (for monitors with revision number before CA)
or	6141-900166A	1	Main chassis 4100N assy*7 (for monitors with revision number CA or later)
61	6141-000807A	1	Upper front enclosure
62	6142-002233A	1	Side panel
63	6143-010249A	2	Shield sheet (left)
64	6143-010258A	1	Shield sheet (right)
65	6114-110222	2	Silicon tube (20 mm long)
66	292042	1	Spacer (20 mm long)
67	6114-108938	1	Spacer
68	6114-073975	1	Hall element
69	128113	1	Spacer (18 mm long)
70	531337	2	Plastic elbow tube
71	531355	2	Check valve
72	1114-221509	1	Elbow tube

*1 For the rear enclosure (Index 9) replacement, the battery label (Index 59) must also be replaced with a new one.

*2 For the motherboard holder (Index 15) replacement, the motherboard cushion sponge (Index 52) must also be replaced with a new one.

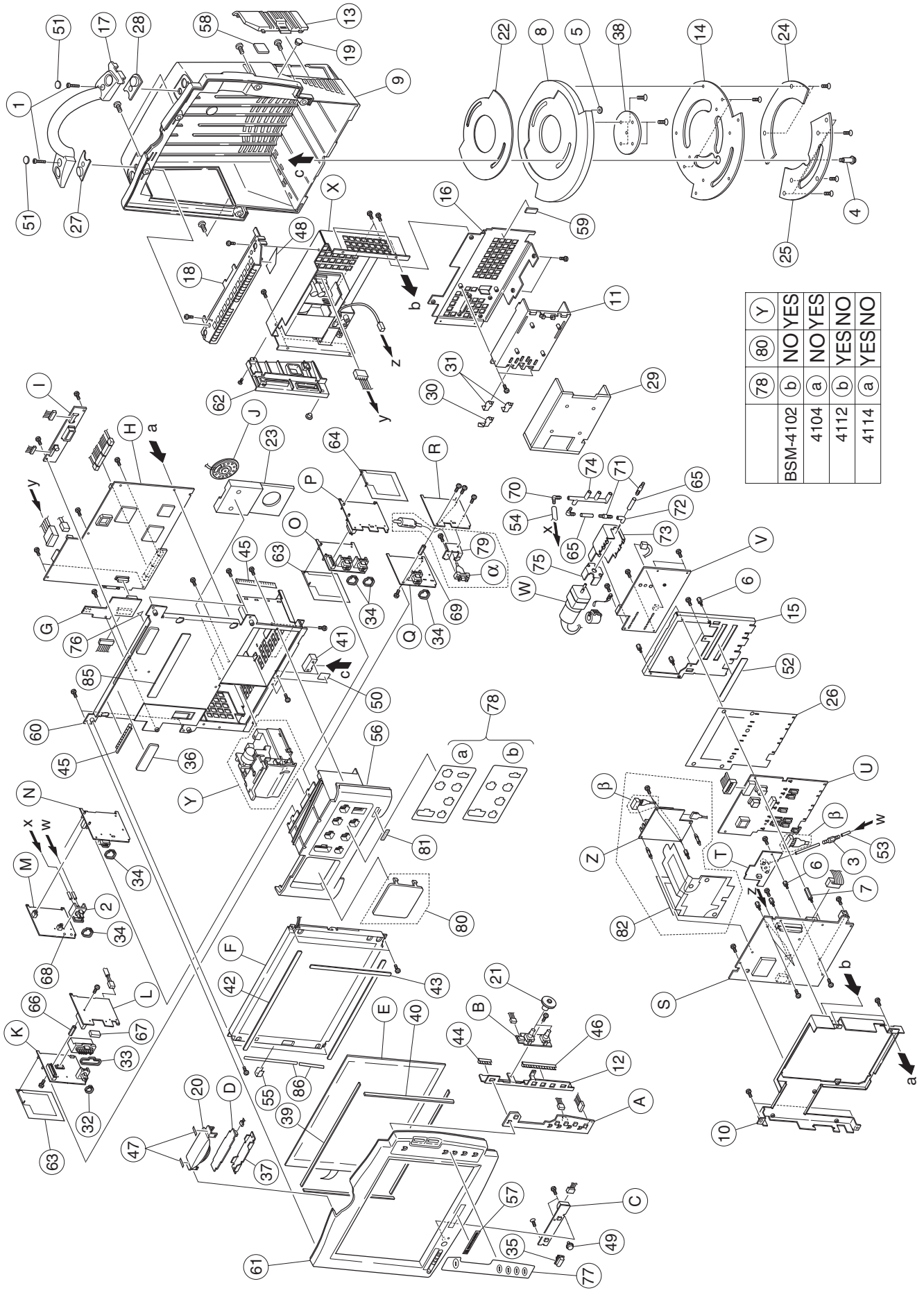
*3 For the handle holder base (Index 18) replacement, the inverter board insulation sheet (Index 48) must also be replaced with a new one.

*4 For the alarm indicator top cover (Index 20) replacement, the two alarm indicator packings (Index 47) must also be replaced with new ones.

*5 For the touch screen (Index E) replacement, the two long and short packings must also be replaced with new ones.

*6 For the LCD unit (Index F) replacement, the two long and short dust protectors (Index 42, 43 and 86) and shielding tape (Index 55) must also be replaced with new ones.

*7 For the main chassis (Index 60) replacement, the insulation sheet for main chassis bottom holder (Index 50) must also be replaced with a new one.



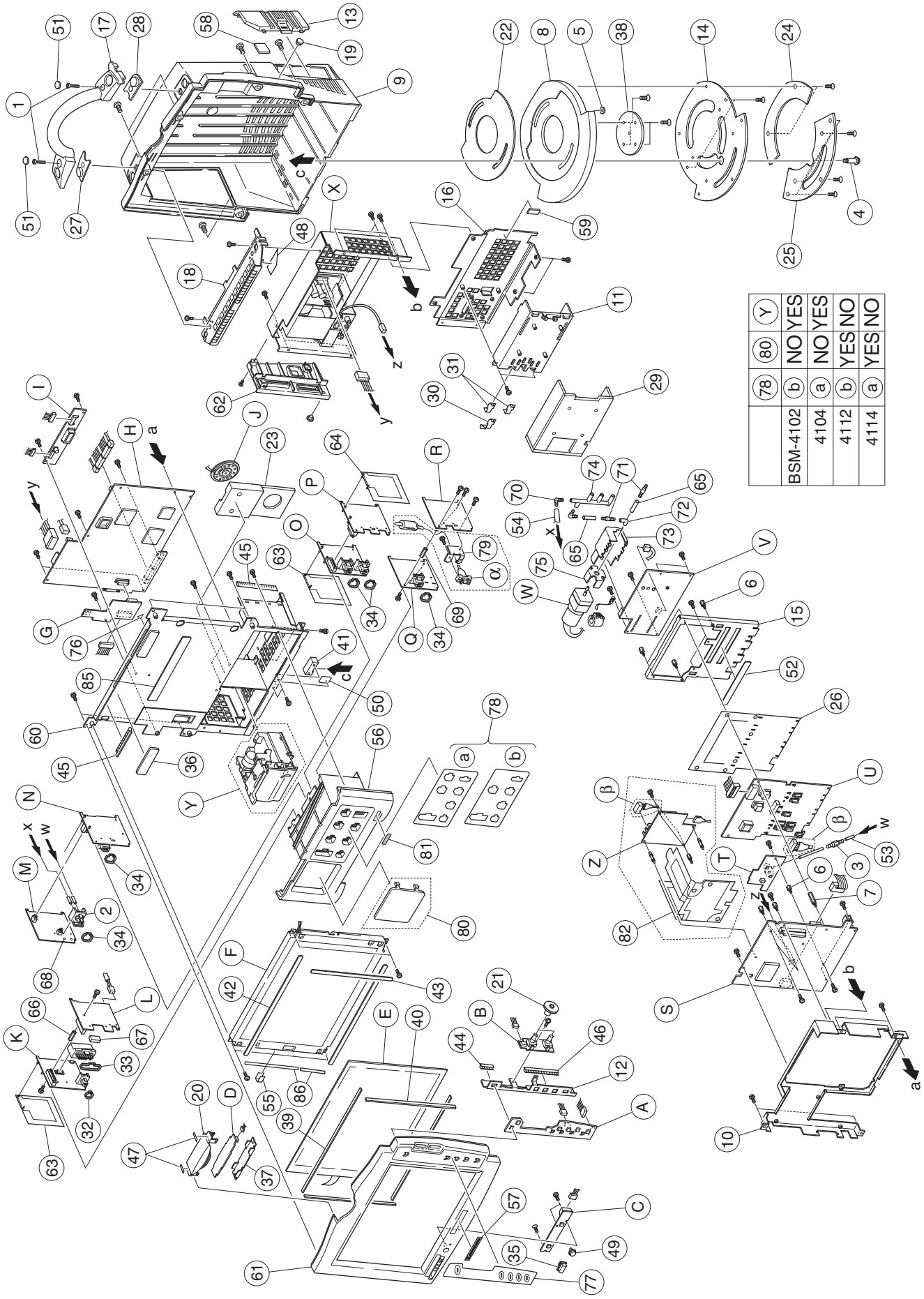
	78	80	Y
BSM-4102	b	NO	YES
4104	a	NO	YES
4112	b	YES	NO
4114	a	YES	NO

Index	NK Code No.	Qty	Description
73	6113-023844D	1	Pump holder
74	6113-037713A	1	Manifold tube
75	6114-073618	1	Sponge
76	1124-037173B	1	High voltage warning label
77	6122-004625A	1	Operation panel sheet
78-a	6123-011936A	1	Input panel for BSM-4104/4114
78-b	6123-011945A	1	Input panel for BSM-4102/4112
79	6114-108421B	1	Nellcor SpO_2 socket holder for BSM-41x2/41x4
80	6112-013857B	1	Recorder blank panel
81	6124-031556	1	BSM-4102A model number label
	6124-031574	1	BSM-4104A model number label
	6124-031672	1	BSM-4112A model number label
	6124-031699	1	BSM-4114A model number label
82	6112-014366A	1	Nellcor SpO_2 module shield sheet
85	915627	1	Gasket (for monitors with revision number CA or later)
86	6114-134909	2	Dust protector (2-S)*6
A	UR-35431	1	Operation board
B	UR-3544	1	Function dial board
C	UR-35421	1	Power SW board
D	576556A	1	Alarm indicator board
E	575833A	1	Touch screen*5
F	575815A	1	LCD unit*6 (for monitors with revision number before CA)
or	916359	1	LCD unit*6 (for monitors with revision number CA or later)
G	UR-3541	1	Connection board
H	UR-3586	1	MAIN board
I	575824A	1	Inverter board
J	575842	1	Speaker
K	UR-3546*7	1	ECG RESP1 board
L	UR-3547*7	1	ECG RESP2 board
M	UR-3548*7	1	ECG RESP3 board
N	UR-35611	1	NL SpO_2 dummy board
O	UR-3557	1	MP1 board
P	UR-3558	1	MP2 board
Q	UR-35592	1	MP3 board for BSM-4104/4114
	UR-35593	1	MP3 dummy board for BSM-4102/4112
R	6190-020774C	1	MP4 board
S	UR-35631	1	DPU board
T	UR-3564	1	NIBP Measure board

*5 For the touch screen (Index E) replacement, the two long and short packings must also be replaced with new ones.

*6 For the LCD unit (Index F) replacement, the two long and short dust protectors (Index 42, 43 and 86) and shielding tape (Index 55) must also be replaced with new ones.

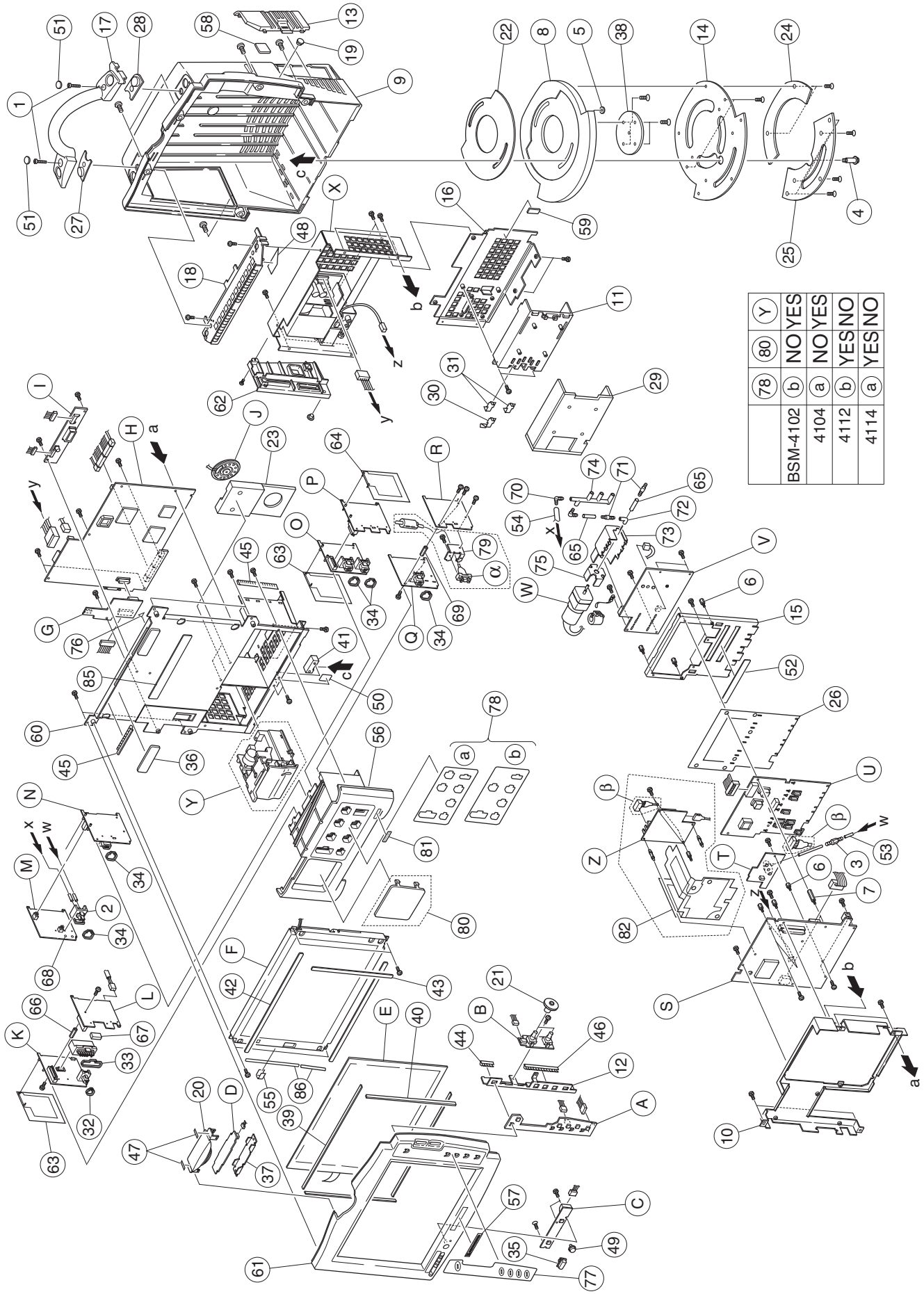
*7 ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.


78 80 Y
BSM-4102 b NO YES
4104 a NO YES
4112 b YES NO
4114 a YES NO

Index	NK Code No.	Qty	Description
U	UR-35661*1	1	Motherboard
V	UR-3567	1	NIBP Safety board
W	532149	1	NIBP pump
X	SC-039R	1	Power supply block
	Consists of the following components.		
	551734	1	Equipotential ground terminal
	6112-013402	1	Power supply unit insulator cover
	6114-107886	1	Inverter board insulation sheet
	6124-009937A	1	Equipotential terminal mark
	6142-002456	1	Upper rear chassis cover
	6142-002233A	1	Side panel
	550013A	1	Power supply unit
	580676	1	AC inlet socket with fuse holder
Y	RG-921P	1	Recorder unit
Z	599478	1	MP304*2 Nellcor SpO_2 module
α	599496	1	Cable with Nellcor SpO_2 socket
β	577056	1	Cable between motherboard and Nellcor SpO_2 module

*1 ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.

***2 When the MP304 is built in the instrument, there is no indication of “NELLCOR OxiMax”. Refer to page 1.20 “On the BSM-4102/4104/4112/4114 Monitors”.**


(78) (80) (Y)
BSM-4102 (b) NO YES
4104 (a) NO YES
4112 (b) YES NO
4114 (a) YES NO

Bedside Monitor BSM-4102/4104/4112/4114 (MP506* included)

*** When the MP506 is built in the instrument, "NELLCOR OxiMax" is indicated below the SpO_2 socket on the front panel. Refer to page 1.20 "On the BSM-4102/4104/4112/4114 Monitors".**

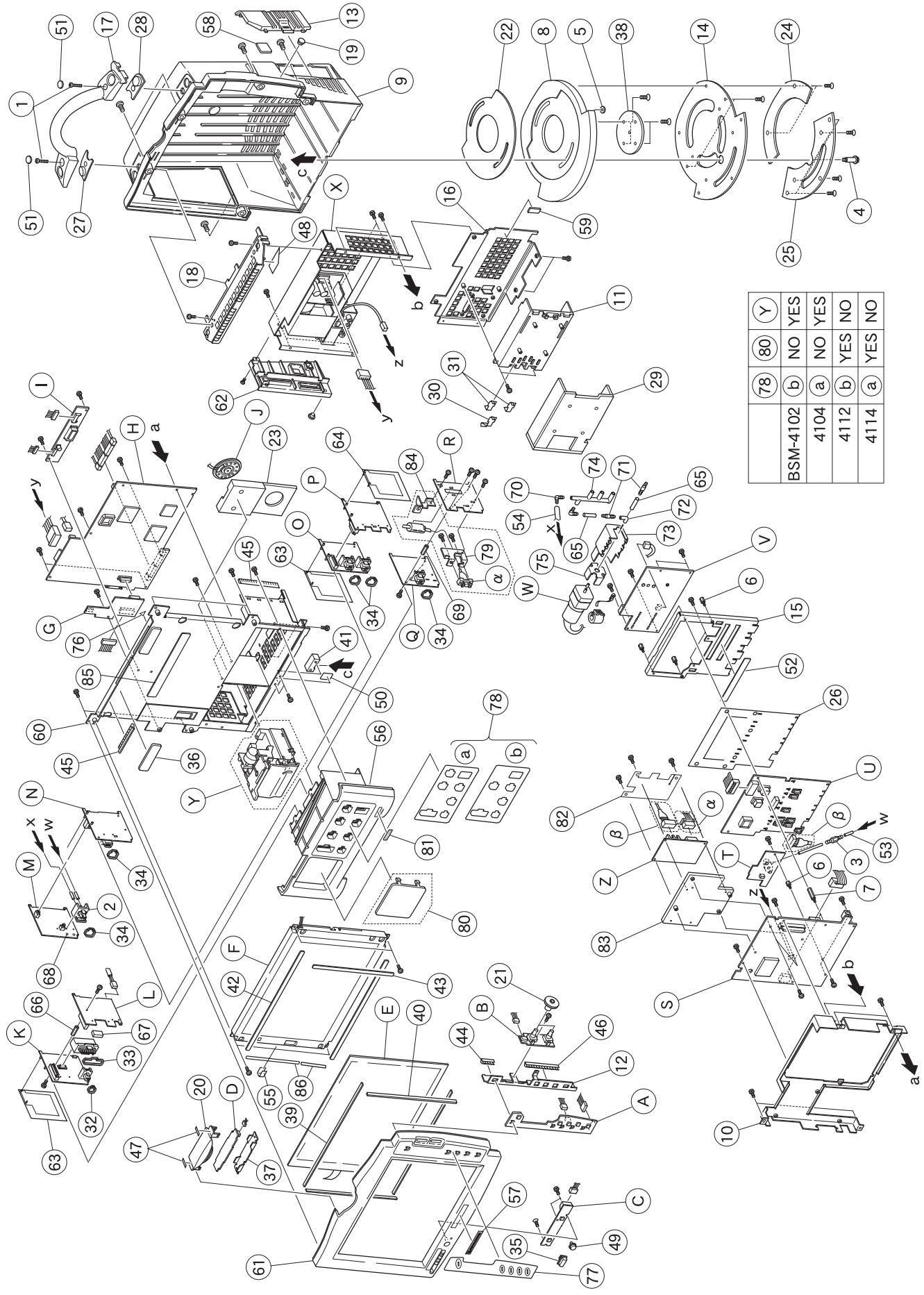
Index	NK Code No.	Qty	Description
1	289848	2	Hexagon socket head bolt
2	515542B	1	NIBP socket
3	531346	1	NIBP air filter
4	577288	1	Collar head screw with spacer
5	579375	1	Washer
6	1114-139714	5	Spacer bolt (7.2 mm long)
7	1114-164116	2	Spacer bolt (27.5 mm long)
8	6111-005618B	1	Swivel base
9	6111-005654B	1	Rear enclosure*1
10	6111-005886C	1	DPU board holder
11	6112-000345B	1	Battery guide enclosure
12	6112-013251E	1	Operation board holder
13	6112-013313B	1	Battery cover
14	6112-013385C	1	Swivel plate
15	6112-013803C	1	Motherboard holder*2
16	6112-013812B	1	Lower rear chassis cover
17	6112-013848B	1	Handle
18	6112-014009A	1	Handle holder base*3
19	6113-029179A	1	ZB-800P socket cover
20	6113-036055A	1	Alarm indicator top cover*4
21	6113-036064A	2	Dial
22	6113-036411A	1	Swivel spacer
23	6113-037125	1	Speaker holder
24	6113-037179A	1	Swivel bottom rubber plate 1
25	6113-037188A	1	Swivel bottom rubber plate 2
26	6113-037419B	1	Motherboard insulation sheet
27	6113-037428B	1	Handle packing (left)
28	6113-037437B	1	Handle packing (right)
29	6113-037794	1	Thermal insulation cover
30	6114-002205A	1	Battery receptacle terminal 1
31	6114-002214	2	Battery receptacle terminal 2
32	6114-073191B	1	ECG/BP OUT socket packing
33	6114-073208A	1	ECG socket packing
34	6114-073217A	5	SpO_2/NIBP/Multi socket packing
35	6114-073556B	1	Power switch top cover
36	6114-074796	2	Heat radiation sheet (for monitors with revision number before CA)
37	6114-105576B	1	Reflector

*1 For the rear enclosure (Index 9) replacement, the battery label (Index 59) must also be replaced with a new one.

*2 For the motherboard holder (Index 15) replacement, the motherboard cushion sponge (Index 52) must also be replaced with a new one.

*3 For the handle holder base (Index 18) replacement, the inverter board insulation sheet (Index 48) must also be replaced with a new one.

*4 For the alarm indicator top cover (Index 20) replacement, the two alarm indicator packings (Index 47) must also be replaced with new ones.


78 80 Y
BSM-4102 b NO YES
4104 a NO YES
4112 b YES NO
4114 a YES NO

Index	NK Code No.	Qty	Description
38	6114-106557	1	Swivel stopper
39	6114-106619A	2	Touch screen packing (long)*5
40	6114-106628A	2	Touch screen packing (short)*5
41	6114-106691B	1	Main chassis bottom holder
42	6114-106789	2	Dust protector (long)*6
43	6114-106798	1	Dust protector (short)*6
44	6114-107208	1	Earth spring with 2 holes (for monitors with revision number before CA)
45	6114-107217	2	Earth spring with 4 holes (for monitors with revision number before CA)
46	6114-107226	1	Earth spring with 5 holes (for monitors with revision number before CA)
47	6114-107877	2	Alarm indicator packing*4
48	6114-107886	1	Inverter board insulation sheet*3
49	6114-108181	1	Record key top cover
50	6114-108261	1	Insulation sheet for main chassis bottom holder*7
51	6114-109438A	2	Rubber cap
52	6114-110098	1	Motherboard cushion sponge*2
53	6114-110204	1	Silicon tube (115 mm long)
54	6114-110213	1	Silicon tube (150 mm long)
55	6114-112657	1	Shielding tape*6 (for monitors with revision number before CA)
56	6122-004714A	1	Lower front enclosure
57	6124-025928	1	Nihon Kohden logo sheet
58	6124-031743	1	ZB-800P label
59	6124-032332	1	Battery label*1
60	6141-000781B	1	Main chassis*7 (for monitors with revision number before CA)
or	6141-900166A	1	Main chassis 4100N assy*7 (for monitors with revision number CA or later)
61	6141-000807A	1	Upper front enclosure
62	6142-002233A	1	Side panel
63	6143-010249A	2	Shield sheet (left)
64	6143-010258A	1	Shield sheet (right)
65	6114-110222	2	Silicon tube (20 mm long)
66	292042	1	Spacer (20 mm long)
67	6114-108938	1	Spacer
68	6114-073975	1	Hall element
69	128113	1	Spacer (18 mm long)
70	531337	2	Plastic elbow tube
71	531355	2	Check valve
72	1114-221509	1	Elbow tube

*1 For the rear enclosure (Index 9) replacement, the battery label (Index 59) must also be replaced with a new one.

*2 For the motherboard holder (Index 15) replacement, the motherboard cushion sponge (Index 52) must also be replaced with a new one.

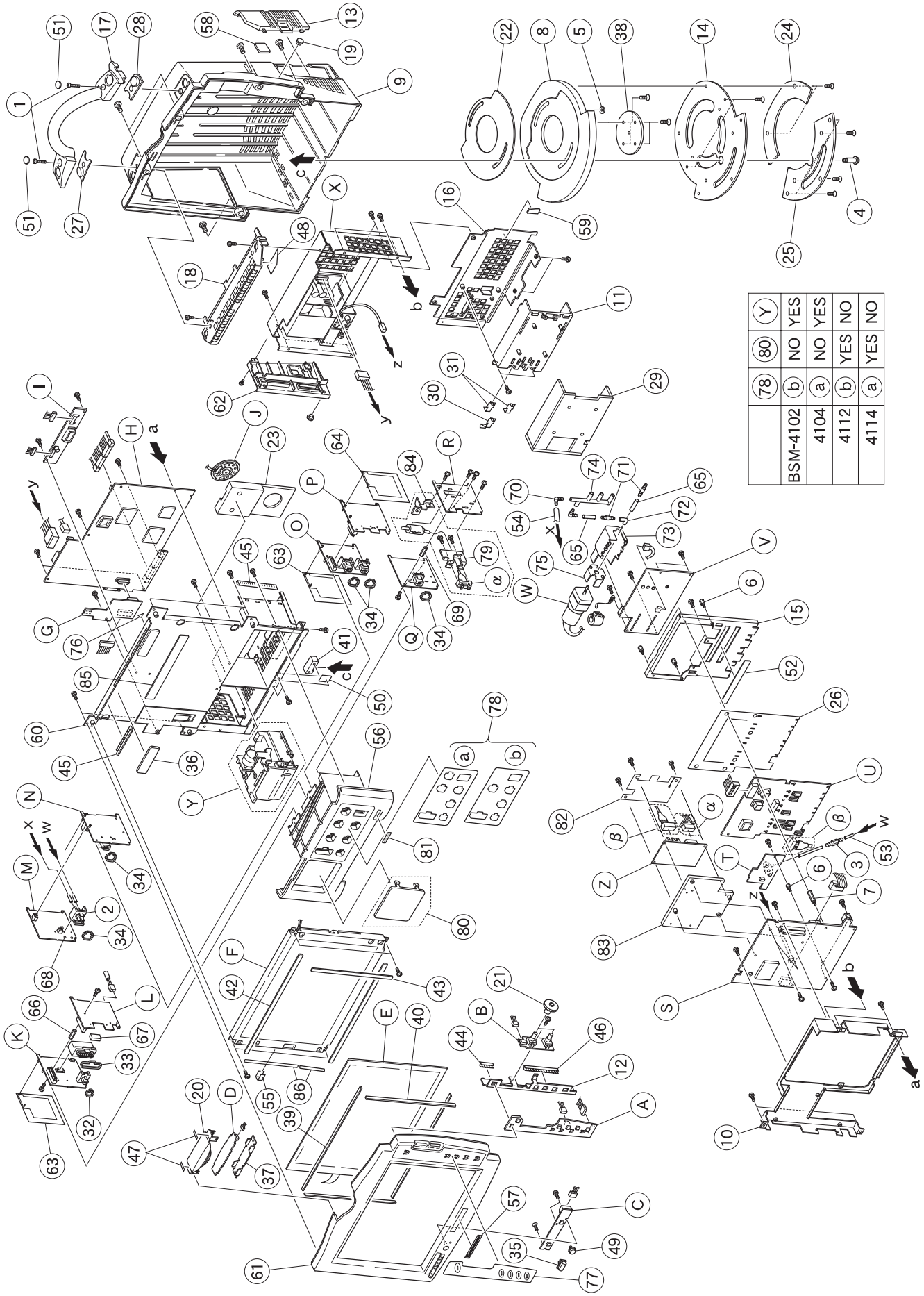
*3 For the handle holder base (Index 18) replacement, the inverter board insulation sheet (Index 48) must also be replaced with a new one.

*4 For the alarm indicator top cover (Index 20) replacement, the two alarm indicator packings (Index 47) must also be replaced with new ones.

*5 For the touch screen (Index E) replacement, the two long and short packings must also be replaced with new ones.

*6 For the LCD unit (Index F) replacement, the two long and short dust protectors (Index 42, 43 and 86) and shielding tape (Index 55) must also be replaced with new ones.

*7 For the main chassis (Index 60) replacement, the insulation sheet for main chassis bottom holder (Index 50) must also be replaced with a new one.



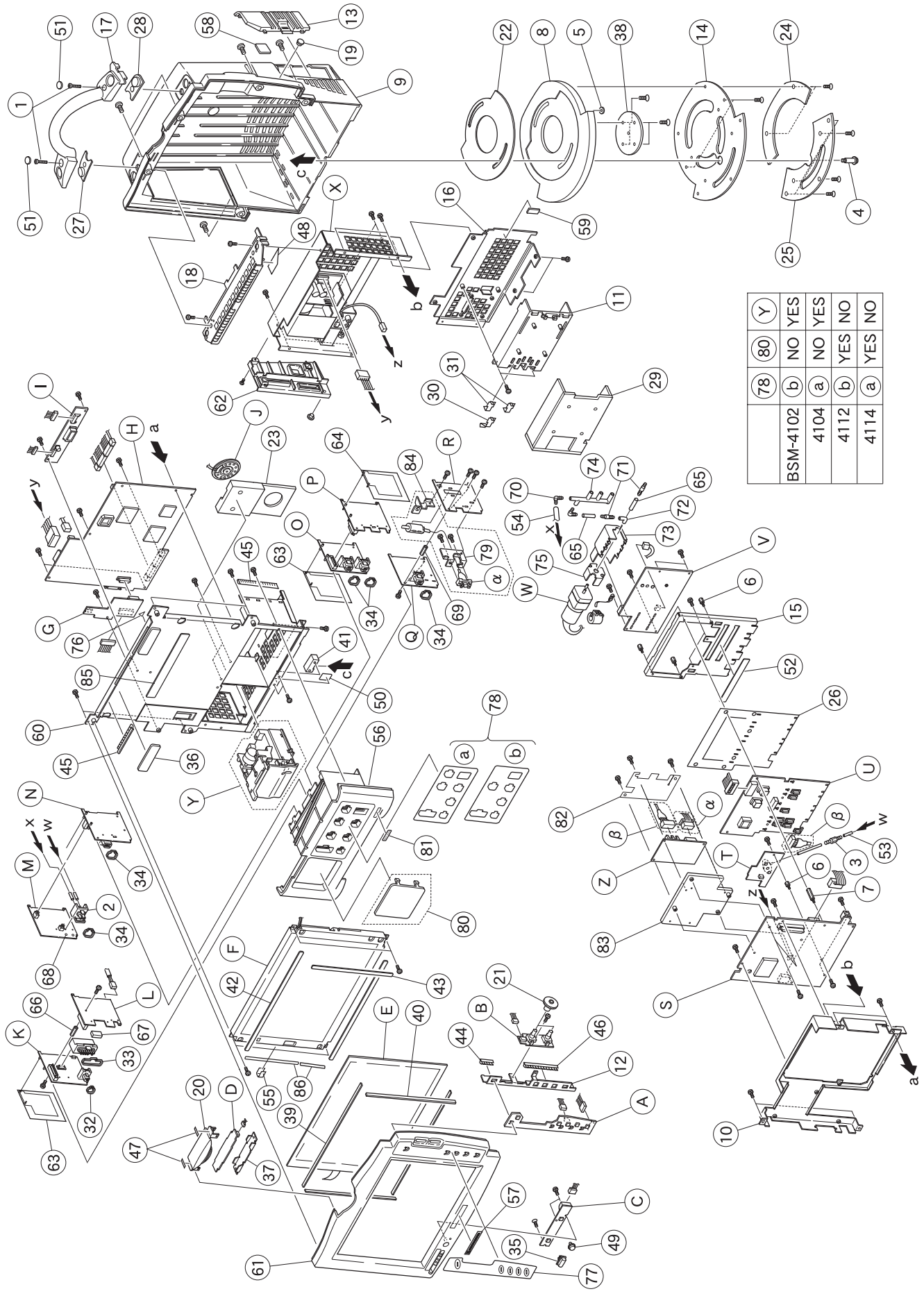
	⑦⑧	⑧⑩	Ⓨ
BSM-4102	ⓑ	NO	YES
4104	ⓐ	NO	YES
4112	ⓑ	YES	NO
4114	ⓐ	YES	NO

Index	NK Code No.	Qty	Description
73	6113-023844D	1	Pump holder
74	6113-037713A	1	Manifold tube
75	6114-073618	1	Sponge
76	1124-037173B	1	High voltage warning label
77	6122-004625A	1	Operation panel sheet
78-a	6123-011936A	1	Input panel for BSM-4104/4114
78-b	6123-011945A	1	Input panel for BSM-4102/4112
79	6114-132635A	1	Nellcor SpO_2 socket holder for BSM-41x2/41x4 (MP506)
80	6112-013857B	1	Recorder blank panel
81	6124-031556	1	BSM-4102A model number label
	6124-031574	1	BSM-4104A model number label
	6124-031672	1	BSM-4112A model number label
	6124-031699	1	BSM-4114A model number label
82	6114-128997	1	Nellcor SpO_2 module insulation sheet
83	6113-045731A	1	Nellcor SpO_2 module support
84	6114-132644	1	Ground bracket
85	915627	1	Gasket (for monitors with revision number CA or later)
86	6114-134909	2	Dust protector (2-S)*6
A	UR-35431	1	Operation board
B	UR-3544	1	Function dial board
C	UR-35421	1	Power SW board
D	576556A	1	Alarm indicator board
E	575833A	1	Touch screen*5
F	575815A	1	LCD unit*6 (for monitors with revision number before CA)
or	916359	1	LCD unit*6 (for monitors with revision number CA or later)
G	UR-3541	1	Connection board
H	UR-3586	1	MAIN board
I	575824A	1	Inverter board
J	575842	1	Speaker
K	UR-3546*7	1	ECG RESP1 board
L	UR-3547*7	1	ECG RESP2 board
M	UR-3548*7	1	ECG RESP3 board
N	UR-35611	1	NL SpO_2 dummy board
O	UR-3557	1	MP1 board
P	UR-3558	1	MP2 board
Q	UR-35592	1	MP3 board for BSM-4104/4114
	UR-35593	1	MP3 dummy board for BSM-4102/4112
R	6190-020774C	1	MP4 board
S	UR-35631	1	DPU board
T	UR-3564	1	NIBP Measure board
U	UR-35661*7	1	Motherboard

*5 For the touch screen (Index E) replacement, the two long and short packings must also be replaced with new ones.

*6 For the LCD unit (Index F) replacement, the two long and short dust protectors (Index 42, 43 and 86) and shielding tape (Index 55) must also be replaced with new ones.

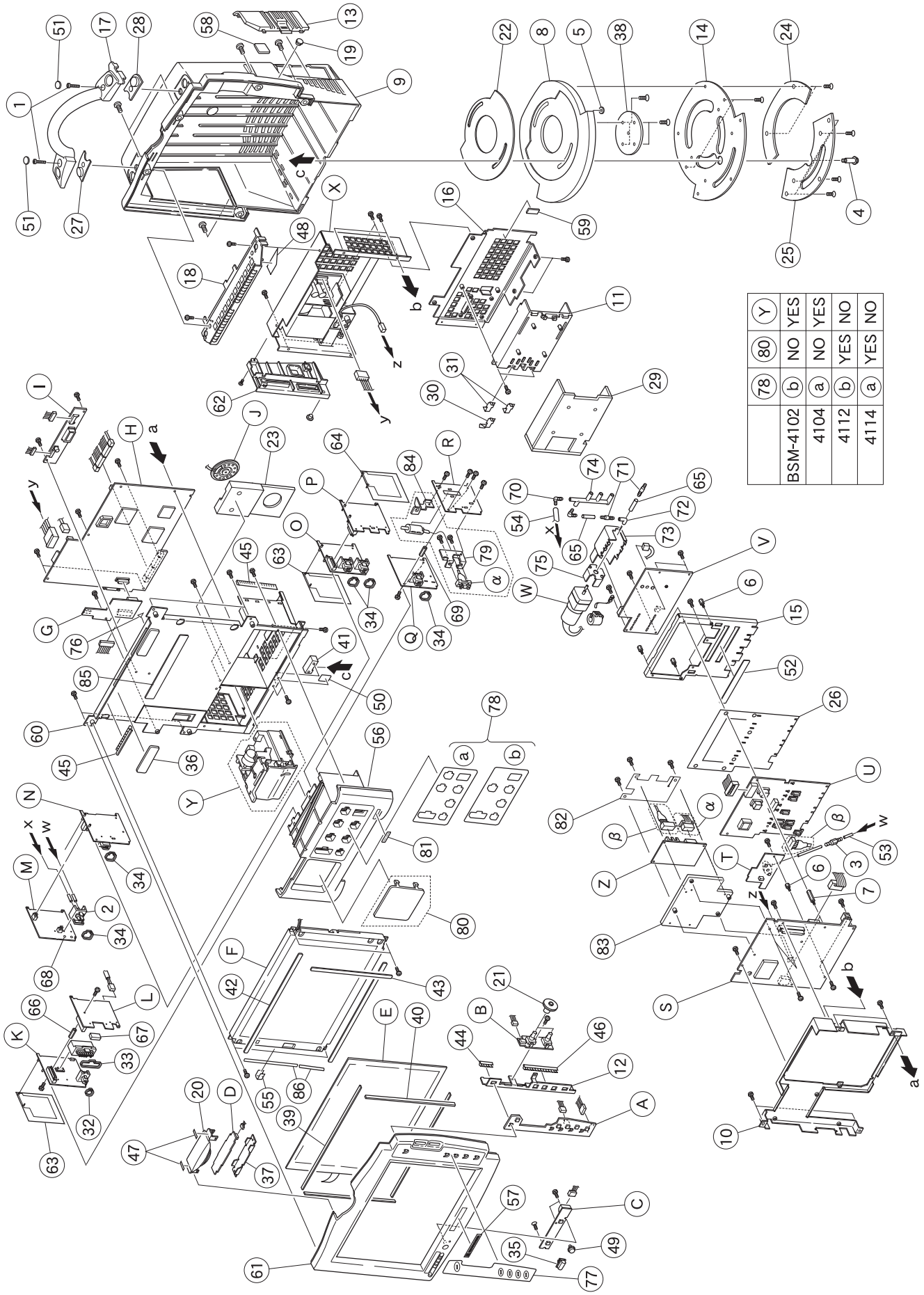
*7 ECG input block repair kit is required when one of the ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.



	78	80	Y
BSM-4102	b	NO	YES
4104	a	NO	YES
4112	b	YES	NO
4114	a	YES	NO

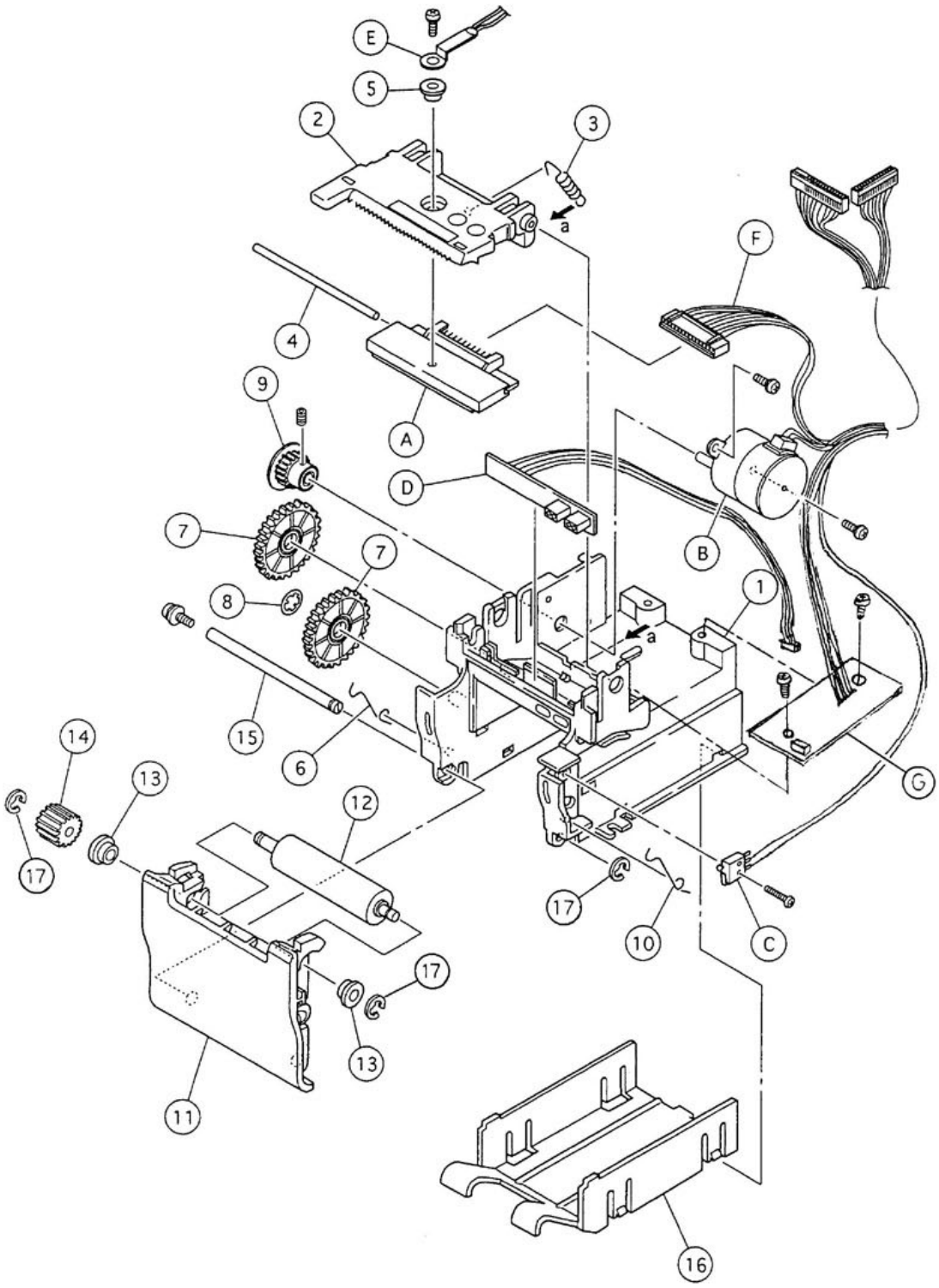
Index	NK Code No.	Qty	Description
V	UR-3567	1	NIBP Safety board
W	532149	1	NIBP pump
X	SC-039R	1	Power supply block
	Consists of the following components.		
	551734	1	Equipotential ground terminal
	6112-013402	1	Power supply unit insulator cover
	6114-107886	1	Inverter board insulation sheet
	6124-009937A	1	Equipotential terminal mark
	6142-002456	1	Upper rear chassis cover
	6142-002233A	1	Side panel
	550013A	1	Power supply unit
	580676	1	AC inlet socket with fuse holder
Y	RG-921P	1	Recorder unit
Z	638017	1	MP506* Nellcor SpO_2 module
α	638071	1	Cable with Nellcor SpO_2 socket
β	577056	1	Cable between motherboard and Nellcor SpO_2 module

*** When the MP506 is built in the instrument, "NELLCOR OxiMax" is indicated below the SpO_2 socket on the front panel. Refer to page 1.20 "On the BSM-4102/4104/4112/4114 Monitors".**


(78) (80) (Y)
BSM-4102 (b) NO YES
4104 (a) NO YES
4112 (b) YES NO
4114 (a) YES NO

RG-921P Recorder Unit

Index	NK Code No.	Qty	Description
1	6111-002327E	1	Recorder chassis
2	6113-017726C	1	Head holder
3	6114-067901A	1	Spring for head
4	6114-053132A	1	Shaft for head
5	515284	1	Bearing for head
6	6114-053141B	1	Spring for magazine door (left)
7	6114-053177C	2	Idle gear
8	515506A	1	Stopper ring
9	6114-053168C	1	Driving gear
10	6114-053159B	1	Spring for magazine door (right)
11	6112-008444C	1	Magazine door
12	6114-053114C	1	Platen roller
13	492503	2	Bearing for magazine door
14	6114-059474B	1	Gear for platen roller
15	6114-053186A	1	Shaft for magazine door
16	6113-023951A	1	Magazine tray
17	107002	3	Retainer ring
A	445074	1	Thermal array head
B	445109B	1	Paper drive motor
C	448053	1	Micro switch
D	UR-3570	1	Sensor board
	578447	2	LED and photo transistor assembly
E	525656A	1	Thermal array head grounding lead
F	449132A	1	Thermal array head connection cable
G	UR-3571	1	Sensor control board



RG-921P

Section 9 Connector Pin Assignment

MAIN Board 9.1
- CN006 (for Speaker) 9.1
- CN101 (for DPU board) 9.2
- CN102 (for Connection board) 9.3
- CN103 (for Power SW board, Operation board and Alarm Indicator board) 9.4
- CN105 (for power supply unit) 9.4
- CN106 (AUX socket) 9.5
- CN107 (for program or network card) 9.6
- CN108 (for Inverter board) 9.7
- CN109 (for QM-421P flash memory) 9.8
- CN114 (REMOTE socket) 9.9
- CN121 (for RG-921P recorder unit) 9.9
- CN122 (for RG-921P recorder unit) 9.10
- CN123 (for RG-921P recorder unit) 9.10

DPU Board 9.11
- CN701 (for MAIN board) 9.11
- CNJ022 (for Motherboard) 9.11
- CNJ013 (for ECG RESP2 board) 9.11
- CNJ031 (for power supply unit) 9.12
- CNJ041 (for NIBP Measure board) 9.12
- CNJ042 (for NIBP Safety board) 9.13
- CN705 (for ZB-800P transmitter) 9.13

Motherboard 9.14
- CNJ701 (for DPU board) 9.14
- CNJ305 (for ECG RESP1 board) 9.14
- CNJ303 (for ECG RESP2 board) 9.14
- CNJ304 (for ECG RESP2 board) 9.15
- CNJ301 (for ECG RESP3 board) 9.15
- CNJ302 (for ECG RESP3 board) 9.16
- CNJ401 (for NK SpO2 board) 9.16
- CNJ601 (for MP2 board) 9.17
- CNJ602 (for MP3 board) 9.17
- CNJ501 (for Nellcor SpO2 board) BSM-4102/4104/4112/4114 only 9.18

Operation Board 9.19

CN101 (for Function Dial board) 9.19
CN102 (for MAIN board) 9.19
Alarm Indicator Board 9.20
CN1 (for MAIN board) 9.20
Power SW Board 9.20
CN101 (for MAIN board) 9.20
Connection Board 9.21
CN101 (for LCD unit) 9.21
CN102 (for touch screen) 9.22
CN103 (for MAIN board) 9.22
Inverter Board 9.23
CN1 (for MAIN board) 9.23
CN2 (for backlight) 9.23
Function Dial Board 9.23
CN101 (for Operation board) 9.23

MAIN Board

CN006 (for Speaker)

Pin Number	Signal Name	Signal Description
1	SND+	Speaker positive
2	SND−	Speaker negative (Ground)
3	NC	Not connected
4	NC	Not connected

CN101 (for DPU board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Address bit 1	A1	1B	1A	A2	Address bit 2
Address bit 3	A3	2B	2A	A4	Address bit 4
Address bit 5	A5	3B	3A	A6	Address bit 6
Address bit 7	A7	4B	4A	E2	Digital ground
Address bit 8	A8	5B	5A	A9	Address bit 9
Address bit 11	A11	6B	6A	A10	Address bit 10
Address bit 13	A13	7B	7A	A12	Address bit 12
Address bit 15	A15	8B	8A	A14	Address bit 14
Digital ground	E2	9B	9A	A16	Address bit 16
Address bit 17	A17	10B	10A	A18	Address bit 18
Address bit 19	A19	11B	11A	A20	Address bit 20
Address bit 21	A21	12B	12A	A22	Address bit 22
Address bit 23	A23	13B	13A	E2	Digital ground
Data bit 0	D0	14B	14A	D1	Data bit 1
Data bit 2	D2	15B	15A	D3	Data bit 3
Data bit 4	D4	16B	16A	D5	Data bit 5
Data bit 6	D6	17B	17A	D7	Data bit 7
Digital ground	E2	18B	18A	D8	Data bit 8
Data bit 9	D9	19B	19A	D10	Data bit 10
Data bit 11	D11	20B	20A	D12	Data bit 12
Data bit 13	D13	21B	21A	D14	Data bit 14
Data bit 15	D15	22B	22A	E2	Digital ground
Digital ground	E2	23B	23A	RXW	Read/Write signal
Lower data strobe output	XLDS	24B	24A	XUDS	Upper data strobe output
Address strobe output	XAS	25B	25A	XIPL0	Interrupt request input 0
Interrupt request input 1	XIPL1	26B	26A	XIPL2	Interrupt request input 2
Data acknowledge input	XDTACK	27B	27A	XBERR	Bus error input
Function code output 0	FC0	28B	28A	FC1	Function code output 1
Function code output 2	FC2	29B	29A	XHALT	Halt input
System reset	XSYSRST	30B	30A	XAC	AC or DC recognition output
DPU reset	XRSTDPU	31B	31A	+15V	+15 V supply voltage
Bus request	XBR	32B	32A	XBG	Bus grant
Digital ground	E2	33B	33A	+15V	+15 V supply voltage
DPU interrupt request input 2	XDPUINT2	34B	34A	XDPUINT1	DPU interrupt request input 1
+15 V supply voltage	+15V	35B	35A	E2	Digital ground
+15 V supply voltage	+15V	36B	36A	KEY7	KEY7 output
+5 V supply voltage	+5V	37B	37A	+3.3V	+3.3 V supply voltage
+5 V supply voltage	+5V	38B	38A	+3.3V	+3.3 V supply voltage
Digital ground	E2	39B	39A	E2	Digital ground
Power-on reset	XPWRRST	40B	40A	C20M_DPU	CPU clock pulse output

CN102 (for Connection board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Touch screen U signal	TOUCH_U	1B	1A	TOUCH_U	Touch screen U signal
Touch screen R signal	TOUCH_R	2B	2A	TOUCH_R	Touch screen R signal
Touch screen A signal	TOUCH_A	3B	3A	TOUCH_A	Touch screen A signal
Touch screen L signal	TOUCH_L	4B	4A	TOUCH_L	Touch screen L signal
Touch screen B signal	TOUCH_B	5B	5A	TOUCH_B	Touch screen B signal
Touch screen D signal	TOUCH_D	6B	6A	TOUCH_D	Touch screen D signal
Touch screen C signal	TOUCH_C	7B	7A	TOUCH_C	Touch screen C signal
Not connected	NC	8B	8A	NC	Not connected
Not connected	NC	9B	9A	NC	Not connected
Not connected	NC	10B	10A	NC	Not connected
Not connected	NC	11B	11A	NC	Not connected
Not connected	NC	12B	12A	NC	Not connected
Not connected	NC	13B	13A	NC	Not connected
Not connected	NC	14B	14A	NC	Not connected
Not connected	NC	15B	15A	NC	Not connected
Not connected	NC	16B	16A	NC	Not connected
Not connected	NC	17B	17A	NC	Not connected
Not connected	NC	18B	18A	NC	Not connected
LCD CK + signal	CKOP	19B	19A	CKOP	LCD CK + signal
LCD CK – signal	CKOM	20B	20A	CKOM	LCD CK – signal
LCD Y2 + signal	Y2P	21B	21A	Y2P	LCD Y2 + signal
LCD Y2 – signal	Y2M	22B	22A	Y2M	LCD Y2 – signal
LCD Y1 + signal	Y1P	23B	23A	Y1P	LCD Y1 + signal
LCD Y1 – signal	Y1M	24B	24A	Y1M	LCD Y1 – signal
LCD Y0 + signal	Y0P	25B	25A	Y0P	LCD Y0 + signal
LCD Y0 – signal	Y0M	26B	26A	Y0M	LCD Y0 – signal
Digital ground	E2	27B	27A	E2	Digital ground
Digital ground	E2	28B	28A	E2	Digital ground
+3.3 V supply voltage	+3.3V	29B	29A	+3.3V	+3.3 V supply voltage
+3.3 V supply voltage	+3.3V	30B	30A	+3.3V	+3.3 V supply voltage

CN103 (for Power SW board, Operation board and Alarm Indicator board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
+15 V supply voltage	+15V	1	2	RED	Red LED cluster control
Yellow LED cluster control	YELLOW	3	4	GREEN	Green LED cluster control
Lower function dial A signal	JOGLA	5	6	JOGLB	Lower function dial B signal
Upper function dial A signal	JOGUA	7	8	JOGUB	Upper function dial B signal
+5 V supply voltage	+5V	9	10	E2	Digital ground
Upper function dial LED	JOGLEDU	11	12	JOGLEDL	Lower function dial LED
SILENCE ALARMS key	KEY0	13	14	KEY8	NIBP INTERVAL key
NIBP START/STOP key	KEY7	15	16	KEY1	MENU key
HOME key	KEY2	17	18	E2	Digital ground
Alarm indicator power supply bus	+15RAW	19	20	KEY9	Power switch
Power lamp	PWR_LED	21	22	STB_LED	AC power lamp
Battery power lamp	BAT1_LED	23	24	BAT2_LED	Battery charging lamp
Digital ground	E2	25	26	E2	Digital ground
Record key	KEY3	27	28	PAP_LED	Out of paper lamp
+5 V supply voltage	+5V	29	30	E2	Digital ground

CN105 (for power supply unit)

Pin Number	Signal Name	Signal Description
1	15VOTS	+15 V supply voltage
2	15VOTS	+15 V supply voltage
3	15VOTS	+15 V supply voltage
4	GND	Ground
5	GND	Ground
6	GND	Ground

CN106 (AUX socket)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Digital ground	E2	1	26	E2	Digital ground
Data Transmit	RSTXD	2	27	RSRXD	Data Receive
Request to Send	XRSRTS	3	28	XRSCTS	Clear to Send
Data Termination Ready	XRSDTR	4	29	XRSCD	Data Set Ready
Inhibit (+5 V supply voltage)	+5V	5	30	+5V	+5 V supply voltage
Digital ground	E2	6	31	E2	Digital ground
Not connected	NC	7	32	NC	Not connected
Inhibit (Reserve 01)	RESV01	8	33	E2	Digital ground
Inhibit (Reserve 02)	RESV02	9	34	RESV03	Inhibit (Reserve 03)
Inhibit (Reserve 04)	RESV04	10	35	RESV05	Inhibit (Reserve 05)
Digital ground	E2	11	36	E2	Digital ground
Inhibit (Reserve 06)	RESV06	12	37	RESV07	Inhibit (Reserve 07)
Digital ground	E2	13	38	RESV08	Inhibit (Reserve 08)
Inhibit (Reserve 09)	RESV09	14	39	RESV10	Inhibit (Reserve 10)
Inhibit (Reserve 11)	RESV11	15	40	RESV12	Inhibit (Reserve 12)
Inhibit (Reserve 13)	RESV13	16	41	NC	Not connected
Inhibit (Reserve 14)	RESV14	17	42	RESV15	Inhibit (Reserve 15)
Digital ground	E2	18	43	E2	Digital ground
Digital red output	RED	19	44	GRET	Digital green output return
Digital red output return	RRET	20	45	GREEN	Digital green output
Digital blue output	BLUE	21	46	E2	Digital ground
Digital blue output return	BRET	22	47	HSYNC	Horizontal synchronous signal
Digital ground	E2	23	48	E2	Digital ground
Digital ground	E2	24	49	VSYNC	Vertical synchronous signal
Digital ground	E2	25	50	E2	Digital ground

CN107 (for program or network card)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Digital ground	E2	1	2	MEMD3	Memory card data bit 3
Memory card data bit 4	MEMD4	3	4	MEMD5	Memory card data bit 5
Memory card data bit 6	MEMD6	5	6	MEMD7	Memory card data bit 7
Memory card chip enable 1	XMEMCE1	7	8	MEMA10	Memory card address bit 10
Memory card output enable	XMOE	9	10	MEMA11	Memory card address bit 11
Memory card address bit 9	MEMA9	11	12	MEMA8	Memory card address bit 8
Memory card address bit 13	MEMA13	13	14	MEMA14	Memory card address bit 14
Memory card write enable	XMWE	15	16	XMCBSY	Memory card busy
+5 V supply voltage	+5V	17	18	+5V	+5 V supply voltage
Memory card address bit 16	MEMA16	19	20	MEMA15	Memory card address bit 15
Memory card address bit 12	MEMA12	21	22	MEMA7	Memory card address bit 7
Memory card address bit 6	MEMA6	23	24	MEMA5	Memory card address bit 5
Memory card address bit 4	MEMA4	25	26	MEMA3	Memory card address bit 3
Memory card address bit 2	MEMA2	27	28	MEMA1	Memory card address bit 1
Digital ground	E2	29	30	MEMD0	Memory card data bit 0
Memory card data bit 1	MEMD1	31	32	MEMD2	Memory card data bit 2
Memory card write protect	MEMCWP	33	34	E2	Digital ground
Digital ground	E2	35	36	XMCD1	Memory card detect bit 1
Memory card data bit 11	MEMD11	37	38	MEMD12	Memory card data bit 12
Memory card data bit 13	MEMD13	39	40	MEMD14	Memory card data bit 14
Memory card data bit 15	MEMD15	41	42	XMEMCE2	Memory card chip enable 2
Not connected	NC	43	44	NC	Not connected
Not connected	NC	45	46	MEMA17	Memory card address bit 17
Memory card address bit 18	MEMA18	47	48	BANK0	Memory bank select bit 0
Memory bank select bit 1	BANK1	49	50	BANK2	Memory bank select bit 2
+5 V supply voltage	+5V	51	52	+5V	+5 V supply voltage
Memory bank select bit 3	BANK3	53	54	BANK4	Memory bank select bit 4
Memory bank select bit 5	BANK5	55	56	BANK6	Memory bank select bit 6
Not connected	NC	57	58	XMRST	Memory card reset
Not connected	NC	59	60	NC	Not connected
Attribute/common memory select	XREG	61	62	XMCBAT2	Memory card battery status bit 2
Memory card battery status bit 1	XMCBAT1	63	64	MEMD8	Memory card data bit 8
Memory card data bit 9	MEMD9	65	66	MEMD10	Memory card data bit 10
Memory card detect bit 2	XMCD2	67	68	E2	Digital ground

CN108 (for Inverter board)

Pin Number	Signal Name	Signal Description
1	+15V	+15 V supply voltage for inverter
2	+15V	+15 V supply voltage for inverter
3	E2	Digital ground
4	E2	Digital ground
5	BCNT	Backlight ON/OFF
6	BCNT_PWM	Brightness control signal
7	NC	Not connected
8	NC	Not connected
9	NC	Not connected
10	NC	Not connected

CN109 (for QM-421P flash memory)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Digital ground	E2	1	2	ATAD3	Memory card data bit 3
Memory card data bit 4	ATAD4	3	4	ATAD5	Memory card data bit 5
Memory card data bit 6	ATAD6	5	6	ATAD7	Memory card data bit 7
Memory card chip enable 1	XATACE1	7	8	ATAA10	Memory card address bit 10
Memory card output enable	XAOE	9	10	ATAA11	Memory card address bit 11
Memory card address bit 9	ATAA9	11	12	ATAA8	Memory card address bit 8
Memory card address bit 13	ATAA13	13	14	ATAA14	Memory card address bit 14
Memory card write enable	XAWE	15	16	XABSY	Memory card busy
Supply voltage for memory card	+5V	17	18	+5V	Supply voltage for memory card
Memory card address bit 16	ATAA16	19	20	ATAA15	Memory card address bit 15
Memory card address bit 12	ATAA12	21	22	ATAA7	Memory card address bit 7
Memory card address bit 6	ATAA6	23	24	ATAA5	Memory card address bit 5
Memory card address bit 4	ATAA4	25	26	ATAA3	Memory card address bit 3
Memory card address bit 2	ATAA2	27	28	ATAA1	Memory card address bit 1
Digital ground	E2	29	30	ATAD0	Memory card data bit 0
Memory card data bit 1	ATAD1	31	32	ATAD2	Memory card data bit 2
Memory card write protect	AWP	33	34	E2	Digital ground
Digital ground	E2	35	36	XACD1	Memory card detect bit 1
Memory card data bit 11	ATAD11	37	38	ATAD12	Memory card data bit 12
Memory card data bit 13	ATAD13	39	40	ATAD14	Memory card data bit 14
Memory card data bit 15	ATAD15	41	42	XATACE2	Memory card chip enable 2
Not connected	NC	43	44	NC	Not connected
Not connected	NC	45	46	ATAA17	Memory card address bit 17
Memory card address bit 18	ATAA18	47	48	ABNK0	Memory bank select bit 0
Memory bank select bit 1	ABNK1	49	50	ABNK2	Memory bank select bit 2
Supply voltage for memory card	+5V	51	52	+5V	Supply voltage for memory card
Memory bank select bit 3	ABNK3	53	54	ABNK4	Memory bank select bit 4
Memory bank select bit 5	ABNK5	55	56	ABNK6	Memory bank select bit 6
Not connected	NC	57	58	ARST	Memory card reset
Not connected	NC	59	60	NC	Not connected
Attribute/common memory select	XAREG	61	62	XABAT2	Memory card battery status bit 2
Memory card battery status bit 1	XABAT1	63	64	ATAD8	Memory card data bit 8
Memory card data bit 9	ATAD9	65	66	ATAD10	Memory card data bit 10
Memory card detect bit 2	XACD2	67	68	E2	Digital ground

CN114 (REMOTE socket)

Pin Number	Signal Name	Signal Description
1	E2	Digital ground
2	+5V	+5 V supply voltage
3	E2	Digital ground
4	RESV_T	Inhibit (Reserve)
5	RESV_R	Inhibit (Reserve)

CN121 (for RG-921P recorder unit)

Pin Number	Signal Name	Signal Description
1	+24V	+24 V supply voltage for thermal array head
2	+24V	+24 V supply voltage for thermal array head
3	E24	+24 V ground return
4	E24	+24 V ground return
5	+5V	+5 V supply voltage
6	THM_5	Thermal array head disable signal detected by thermistor
7	NTHENB	Thermal array head enable signal
8	NTHENB	Thermal array head enable signal
9	THCLK	Serial data transfer clock
10	NTHSTB	Thermal array head strobe signal
11	THDAT	Thermal array head serial data
12	E24	+24 V ground return
13	E24	+24 V ground return
14	+24V	+24 V supply voltage for thermal array head
15	+24V	+24 V supply voltage for thermal array head

CN122 (for RG-921P recorder unit)

Pin Number	Signal Name	Signal Description
1	MA1	Motor phase control A
2	MB1	Motor phase control B
3	MA2	Motor phase control A
4	MB2	Motor phase control B
5	+3.3V	+3.3 V supply voltage
6	MOP_5	Magazine condition detected signal
7	+5V	+5 V supply voltage
8	E2	Digital ground
9	SNSON1	Paper sensor enable signal
10	PEMP_5	Paper detected signal
11	SNSON2	Mark sensor enable signal
12	MK_5	Mark detected signal

CN123 (for RG-921P recorder unit)

Pin Number	Signal Name	Signal Description
1	E2	Digital ground
2	E2	Digital ground

DPU Board

CN701 (for MAIN board)

Refer to “CN101 (for DPU board)” in the “MAIN Board” section.

CNJ022 (for Motherboard)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Address bus bit 2	CLK	A1	B1	VBUS	+15 V supply voltage
Analog ground	AGND	A2	B2	VBUS	+15 V supply voltage
SpO_2 digitized data	SPO2	A3	B3	VBUS	+15 V supply voltage
+3.3 V supply voltage	+3.3V	A4	B4	TGND	Ground for +15 V
Nellcor serial data (TXD)	NEL_TXD	A5	B5	TGND	Ground for +15 V
Nellcor serial data (RXD)	NEL_RXD	A6	B6	TGND	Ground for +15 V
IBP waveform output	IBP_PWM	A7	B7	+8V	+8 V supply voltage for analog circuit
SpO_2 serial data (TXD)	SPO2_TXD	A8	B8	AECGOUT	ECG/RESP digitized data
SpO_2 serial data (RXD)	SPO2_RX	A9	B9	−8V	−8 V supply voltage for analog circuit
Digital ground	E2	A10	B10	ECG_RXD	ECG serial data (RXD)
SpO_2 gate array clock	SAMPCK	A11	B11	ECG_TXD	ECG serial data (TXD)
Digital ground	E2	A12	B12	E2	Digital ground
200 kHz clock	FCLK	A13	B13	COMMAND	12 lead ECG command
Digital ground	E2	A14	B14	ECGDATA	12 lead ECG data
MP serial data (TXD)	DPU_MP_TXD	A15	B15	+5VD	+5 V supply voltage
MP serial data (RXD)	DPU_MP_RXD	A16	B16	CLK	8 kHz clock
MP reset	nMP_RST	A17	B17	XPM_DTECT	Pacing pulse detection

CNJ013 (for ECG RESP2 board)

Pin Number	Signal Name	Signal Description
1	AGNDAOF	Analog ground
2	FBP	Blood pressure waveform output (BP)
3	FHT	Heart rate analog output (HT)
4	FECG	ECG waveform output

CNJ031 (for power supply unit)

Pin Number	Signal Name	Signal Description
1	AC_CLK	Line frequency detection (50/60 Hz)
2	AGND	Analog ground

CNJ041 (for NIBP Measure board)

Pin Number	Signal Name	Signal Description
1	PRESS	Cuff pressure output
2	PULSE	Pulse complex output
3	AGND	Analog ground
4	AGND	Analog ground
5	—	Protection pin against erroneous connection
6	INST	Pulse complex baseline recovery
7	+5V	+5 V supply voltage
8	–5V	–5 V supply voltage
9	+8V	+8 V supply voltage
10	–8V	–8 V supply voltage

CNJ042 (for NIBP Safety board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Safety circuit cuff pressure	SPRESS	A1	B1	PUMP	Pump control
+5 V supply voltage	+5VD	A2	B2	BRAKE	Pump brake
+5 V supply voltage	+5VD	A3	B3	VALVE1	Valve1 control
Digital ground	E2	A4	B4	VALVE2	Valve2 control
+8 V supply voltage	+8V	A5	B5	HW_ERR	Safety circuit abnormal
Digital ground	E2	A6	B6	CANCEL	Safety circuit
Digital ground	E2	A7	B7	INT	Periodic measurement interval
Analog ground	AGND	A8	B8	CUFF0	Measurement mode 0
Analog ground	AGND	A9	B9	CUFF1	Measurement mode 1
+6 V ground	EP	A10	B10	IEC_ERR	IEC standard error
+6 V ground	EP	A11	B11	XNIBPSS	Measure/Stop
+6 V ground	EP	A12	B12	INTRET	INT return
+6 V ground	EP	A13	B13	CANCELRET	CANCEL return
+6 V supply voltage	+6V	A14	B14	CUFF1RET	CUFF1 return
+6 V supply voltage	+6V	A15	B15	CUFF0RET	CUFF0 return
+6 V supply voltage	+6V	A16	B16	NIBPSSRET	XNIBPSS return
+6 V supply voltage	+6V	A17	B17	ZEROEND	Zeroing completion

CN705 (for ZB-800P transmitter)

Pin Number	Signal Name	Signal Description
1	+5VD	+5 V supply voltage
2	E2	Digital ground
3	+8V	+8 V supply voltage
4	AGND	Analog ground
5	ECG_DA	ECG analog output
6	NC	Not connected
7	ZB_RXD	Serial data (RXD)
8	ZB_TXD	Serial data (TXD)
9	ZB_CLK	Clock
10	ZB_RST	Reset

Motherboard

CNJ701 (for DPU board)

Refer to “CNJ022 (for Motherboard)” in the “DPU Board” section.

CNJ305 (for ECG RESP1 board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Protective earth	PGND	A1	B1	PGND	Protective earth
Protective earth	PGND	A2	B2	PGND	Protective earth
Protective earth	PGND	A3	B3	PGND	Protective earth
Protective earth	PGND	A4	B4	PGND	Protective earth
Protective earth	PGND	A5	B5	PGND	Protective earth
Protective earth	PGND	A6	B6	PGND	Protective earth
Protective earth	PGND	A7	B7	PGND	Protective earth
Protective earth	PGND	A8	B8	PGND	Protective earth
Protective earth	PGND	A9	B9	PGND	Protective earth
Protective earth	PGND	A10	B10	PGND	Protective earth

CNJ303 (for ECG RESP2 board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Respiration circuit ground	ER	A1	B1	RESP	Respiration digitized data
Respiration circuit ground	ER	A2	B2	AGNDF	Analog ground
Analog ground	AGNDF	A3	B3	Z0	Respiration measure
Analog ground	AGNDF	A4	B4	RINST	Respiration baseline recovery
+8 V supply voltage for analog circuit	+8VF	A5	B5	RSEL	Respiration electrode select
−8 V supply voltage for analog circuit	−8VF	A6	B6	PWMI	Lead I time constant adjust
+2.5 V reference voltage	AVR+	A7	B7	PWMII	Lead II time constant adjust
−2.5 V reference voltage	AVR−	A8	B8	PWM[01]	Lead C1 time constant adjust
+2.5 V supply voltage	+2.5VF	A9	B9	PWM[02]	Lead C2 time constant adjust
−2.5 V supply voltage	−2.5VF	A10	B10	PWM[03]	Lead C3 time constant adjust
+8 V supply voltage for respiration	+8VFR	A11	B11	PWM[04]	Lead C4 time constant adjust
−8 V supply voltage for respiration	−8VFR	A12	B12	PWM[05]	Lead C5 time constant adjust
Carrier frequency for respiration	125kHz	A13	B13	PWM[06]	Lead C6 time constant adjust
+3 V supply voltage for analog circuit	+VAN	A14	B14	CAL	Calibration control
−3 V supply voltage for analog circuit	−VAN	A15	B15	XDC_CHECK	12 lead electrode polarization voltage detection

CNJ304 (for ECG RESP2 board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Polarity detection electrode select	MUX[0]	A1	B1	BII	Lead II ECG
Polarity detection electrode select	MUX[1]	A2	B2	BC1	Lead C1 ECG
Polarity detection electrode select	MUX[2]	A3	B3	BC2	Lead C2 ECG
Polarity detection electrode select	MUX[3]	A4	B4	BC3	Lead C3 ECG
Polarity detection electrode select	MUX[4]	A5	B5	BC4	Lead C4 ECG
Polarity detection electrode select	MUX[5]	A6	B6	BC5	Lead C5 ECG
Resolution control clock	1MS	A7	B7	BC6	Lead C6 ECG
Pacing pulse detection	PM_DETCT	A8	B8	AGNDF	Analog ground
BR-903P detection	3L	A9	B9	AGNDF	Analog ground
BR-906P detection	36L	A10	B10	AGNDF	Analog ground
ECG output lead select 0	AECGSEL0	A11	B11	AGNDF	Analog ground
ECG output lead select 1	AECGSEL1	A12	B12	AGNDF	Analog ground
ECG output lead select 2	AECGSEL2	A13	B13	FBSEL0	Feedback electrode select 0
ECG output lead select 3	AECGSEL3	A14	B14	FBSEL1	Feedback electrode select 1
Lead I ECG	BI	A15	B15	AECG	ECG digitized data

CNJ301 (for ECG RESP3 board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Analog ground	AGNDF	A1	B1	F_TXD	Status (TXD)
Analog ground	AGNDF	A2	B2	F_RXD	Status (RXD)
Analog ground	AGNDF	A3	B3	Z0	Respiration measure
Analog ground	AGNDF	A4	B4	RINST	Respiration baseline recovery
+8 V supply voltage for analog circuit	+8VF	A5	B5	RSEL	Respiration electrode select
−8 V supply voltage for analog circuit	−8VF	A6	B6	PWMI	Lead I time constant adjust
+2.5 V reference voltage	AVRF+	A7	B7	PWMII	Lead II time constant adjust
−2.5 V reference voltage	AVRF−	A8	B8	PWM[01]	Lead C1 time constant adjust
+2.5 V supply voltage	+2.5VF	A9	B9	PWM[02]	Lead C2 time constant adjust
−2.5 V supply voltage	−2.5VF	A10	B10	PWM[03]	Lead C3 time constant adjust
Command data	CMD	A11	B11	PWM[04]	Lead C4 time constant adjust
12 lead ECG data	SDAT	A12	B12	PWM[05]	Lead C5 time constant adjust
Carrier frequency for respiration	125kHz	A13	B13	PWM[06]	Lead C6 time constant adjust
Floating control clock	F_ECLK	A14	B14	CAL	Calibration control
Floating synchronization	F_ESYNC	A15	B15	XDC_CHECK	12 lead electrode polarization voltage detection

CNJ302 (for ECG RESP3 board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Polarity detection electrode select	MUX[0]	A1	B1	BII	Lead II ECG
Polarity detection electrode select	MUX[1]	A2	B2	BC1	Lead C1 ECG
Polarity detection electrode select	MUX[2]	A3	B3	BC2	Lead C2 ECG
Polarity detection electrode select	MUX[3]	A4	B4	BC3	Lead C3 ECG
Polarity detection electrode select	MUX[4]	A5	B5	BC4	Lead C4 ECG
Polarity detection electrode select	MUX[5]	A6	B6	BC5	Lead C5 ECG
Resolution control clock	1MS	A7	B7	BC6	Lead C6 ECG
Pacing pulse detection	PM_DETCT	A8	B8	PWRCONT	Supply voltage control
BR-903P detection	3L	A9	B9	F_AECGOUT	Floating ECG digitized data
BR-906P detection	36L	A10	B10	AGNDF	Analog ground
ECG output lead select 0	AECGSEL0	A11	B11	AGNDF	Analog ground
ECG output lead select 1	AECGSEL1	A12	B12	8kHz	A/D timing synchronous clock
ECG output lead select 2	AECGSEL2	A13	B13	FBSEL0	Feedback electrode select 0
ECG output lead select 3	AECGSEL3	A14	B14	FBSEL1	Feedback electrode select 1
Lead I ECG	BI	A15	B15	AECG	ECG digitized data

CNJ401 (for NK SpO2 board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
+10 V supply voltage for analog circuit	+10UF	A1	B1	EF	Floating ground
+10 V supply voltage for analog circuit	+10UF	A2	B2	F_SPO2	SpO_2 digitized multiplexed data
Ground for LED	LEF	A3	B3	EF	Floating ground
Floating ground	EF	A4	B4	NC	Not connected
+2.5 V supply voltage for analog circuit	+2.5F	A5	B5	EF	Floating ground
Ground for LED	LEF	A6	B6	F_SCLK	Floating control clock
+5 V supply voltage for digital circuit	+5DF	A7	B7	EF	Floating ground
+5 V supply voltage for digital circuit	+5DF	A8	B8	F_SSYNC	Floating synchronization
−2.5 V supply voltage for analog circuit	−2.5F	A9	B9	EF	Floating ground
+5 V supply voltage for analog circuit	+5F	A10	B10	F_SPO2_RXD	Floating SpO_2 control (output)
+5 V supply voltage for analog circuit	+5F	A11	B11	EF	Floating ground
Floating ground	EF	A12	B12	F_SAMPCK	Floating gate array clock
−5 V supply voltage for analog circuit	−5F	A13	B13	EF	Floating ground
−5 V supply voltage for analog circuit	−5F	A14	B14	F_SPO2_TXD	Floating SpO_2 control (input)
Floating ground	EF	A15	B15	EF	Floating ground

CNJ601 (for MP2 board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Floating analog ground	AEF	A1	B1	DEF	Floating digital ground
+5 V floating for analog circuit	+5VAF	A2	B2	+6VDF	+6 V floating for digital circuit
MP1 BP positive output	BP+_3	A3	B3	MP_RXD	MP serial data (RXD)
MP1 BP negative output	BP-_3	A4	B4	MP_TXD	MP serial data (TXD)
–5 V floating for analog circuit	–5VAF	A5	B5	nRST	Reset
Reference voltage	VREF	A6	B6	CO2_RXD_3	MP1 CO2 serial data (RXD)
+2.5 V exciter voltage	EXT25	A7	B7	CO2_TXD_3	MP1 CO2 serial data (TXD)
–0.5 V exciter voltage	EXT05	A8	B8	ROM_CLK_3	MP1 EEPROM clock
+5 V floating for analog circuit	+5VAF	A9	B9	ROM_DATA_3	MP1 EEPROM data
MP1 status	MP3_SL	A10	B10	SW_3	IBP key status
Floating analog ground	AEF	A11	B11	F_IBP_PWM	BP PWM output
MP1 common input	COM1_3	A12	B12	EXT_CTRL0_3	MP1 exciter setting
MP1 common input	COM2_3	A13	B13	EXT_CTRL1_3	MP1 exciter setting
ROM write in microprocessor	ROM_W_SL	A14	B14	+6VDF	+6 V floating for digital circuit
MP1 connection recognition	GND_MP_3	A15	B15	DEF	Digital ground

CNJ602 (for MP3 board)

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Floating analog ground	AEF	A1	B1	DEF	Floating digital ground
+5 V floating for analog circuit	+5VAF	A2	B2	+6VDF	+6 V floating for digital circuit
MP1 BP positive output	BP+_3	A3	B3	MP_RXD	MP serial data (RXD)
MP1 BP negative output	BP-_3	A4	B4	MP_TXD	MP serial data (TXD)
–5 V floating for analog circuit	–5VAF	A5	B5	nRST	Reset
Reference voltage	VREF	A6	B6	CO2_RXD_3	MP1 CO2 serial data (RXD)
+2.5 V exciter voltage	EXT25	A7	B7	CO2_TXD_3	MP1 CO2 serial data (TXD)
–0.5 V exciter voltage	EXT05	A8	B8	ROM_CLK_3	MP1 EEPROM clock
+5 V floating for analog circuit	+5VAF	A9	B9	ROM_DATA_3	MP1 EEPROM data
MP1 status	MP3_SL	A10	B10	SW_3	IBP key status
Floating analog ground	AEF	A11	B11	F_IBP_PWM	BP PWM output
MP1 common input	COM1_3	A12	B12	EXT_CTRL0_3	MP1 exciter setting
MP1 common input	COM2_3	A13	B13	EXT_CTRL1_3	MP1 exciter setting
ROM write in microprocessor	ROM_W_SL	A14	B14	+6VDF	+6 V floating for digital circuit
MP1 connection recognition	GND_MP_3	A15	B15	DEF	Digital ground

CNJ501 (for Nellcor SpO2 board) BSM-4102/4104/4112/4114 only

Signal Description	Signal Name	Pin Number		Signal Name	Signal Description
Not connected	N.C.	1	2	EF	Floating ground
Floating ground	EF	3	4	RESET	Reset output
Floating ground	EF	5	6	N.C.	Not connected
−5 V for analog circuit	−5F	7	8	NEL_TX	MP304/MP506 serial data (RXD)
MP304/MP506 serial data (TXD)	NEL_RX	9	10	+5F	+5 V for analog circuit
CTS output to MP506	N.C. at MP304	11	12	EF	Floating ground
	EF at MP506*		14	XNEL	MP304/MP506 connection recognition
+5 V for digital circuit	+5DF	13			

*** When the MP506 is built in the instrument, "NELLCOR OxiMax" is indicated below the SpO_2 socket on the front panel. Refer to page 1.20 "On the BSM-4102/4104/4112/4114 Monitors".**

Operation Board

CN101 (for Function Dial board)

Pin Number	Signal Name	Signal Description
1	JOGL_A	Lower function dial A signal
2	JOGL_B	Lower function dial B signal
3	JOGU_A	Upper function dial A signal
4	JOGU_B	Upper function dial B signal
5	+5V	+5 V supply voltage
6	E2	Digital ground
7	XLED_JOGU	Upper function dial LED
8	XLED_JOGL	Lower function dial LED
9	E2	Digital ground
10	E2	Digital ground

CN102 (for MAIN board)

Pin Number	Signal Name	Signal Description
1	JOGL_A	Lower function dial A signal
2	JOGL_B	Lower function dial B signal
3	JOGU_A	Upper function dial A signal
4	JOGU_B	Upper function dial B signal
5	+5V	+5 V supply voltage
6	E2	Digital ground
7	XLED_JOGU	Upper function dial LED
8	XLED_JOGL	Lower function dial LED
9	XKEY1	SILENCE ALARMS key
10	XKEY2	NIBP INTERVAL key
11	XKEY3	NIBP START/STOP key
12	XKEY4	MENU key
13	XKEY5	HOME key
14	E2	Digital ground
15	E2	Digital ground
16	E2	Digital ground
17	E2	Digital ground
18	E2	Digital ground
19	E2	Digital ground
20	E2	Digital ground

Alarm Indicator Board

CN1 (for MAIN board)

Pin Number	Signal Name	Signal Description
1	+15V	+15 V supply voltage
2	XRED	Red LED cluster control
3	XYELLOW	Yellow LED cluster control
4	XGREEN	Green LED cluster control

Power SW Board

CN101 (for MAIN board)

Pin Number	Signal Name	Signal Description
1	+15V	+15 V supply voltage
2	XKEY_POWER	Power switch
3	XLED_POWER	Power LED
4	XLED_STBY	AC power LED
5	XLED_BATOP	Battery power LED
6	XLED_BTCHG	Battery charging LED
7	E2	Digital ground
8	E2	Digital ground
9	XKEY_REC	Record key
10	XLED_PAPER	Out of paper LED
11	+5V	+5 V supply voltage
12	E2	Digital ground

Connection Board

CN101 (for LCD unit)

Pin Number	Signal Name	Signal Description
1	+3.3V	+3.3 V supply voltage
2	+3.3V	+3.3 V supply voltage
3	E2	Digital ground
4	E2	Digital ground
5	IN0−	LCD Y0 − signal
6	IN0+	LCD Y0 + signal
7	IN1−	LCD Y1 − signal
8	IN1+	LCD Y1 + signal
9	IN2−	LCD Y2 − signal
10	IN2+	LCD Y2 + signal
11	CLKIN−	LCD CK − signal
12	CLKIN+	LCD CK + signal
13	NC	Not connected
14	NC	Not connected
15	NC	Not connected
16	NC	Not connected
17	NC	Not connected
18	NC	Not connected
19	NC	Not connected
20	NC	Not connected

CN102 (for touch screen)

Pin Number	Signal Name	Signal Description
1	NC	Not connected
2	TOUCH_U	Touch screen U signal
3	NC	Not connected
4	TOUCH_R	Touch screen R signal
5	NC	Not connected
6	TOUCH_A	Touch screen A signal
7	NC	Not connected
8	TOUCH_L	Touch screen L signal
9	NC	Not connected
10	TOUCH_B	Touch screen B signal
11	NC	Not connected
12	TOUCH_D	Touch screen D signal
13	NC	Not connected
14	TOUCH_C	Touch screen C signal
15	NC	Not connected

CN103 (for MAIN board)

Refer to “CN102 (for Connection board)” in the “MAIN board” section.

Inverter Board

CN1 (for MAIN board)

Pin Number	Signal Name	Signal Description
1	+15V	+15 V supply voltage for inverter
2	+15V	+15 V supply voltage for inverter
3	E2	Digital ground
4	E2	Digital ground
5	CNT	Backlight ON/OFF control
6	VR	Brightness control
7	NC	Not connected
8	NC	Not connected

CN2 (for backlight)

Pin Number	Signal Name	Signal Description
1	Vout-Lo	Low voltage output for backlight (cold cathode tube)
2	NC	Not connected
3	NC	Not connected
4	NC	Not connected
5	Vout-Hi	High voltage output for backlight (cold cathode tube)
6	NC	Not connected
7	Vout-Hi	High voltage output for backlight (cold cathode tube)

Function Dial Board

CN101 (for Operation board)

Refer to “CN101 (for Function Dial board)” in the “Operation Board” section.

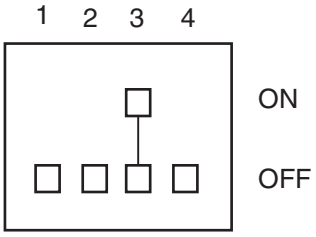
Section 10 Internal Switch Setting and Board Compatibility

Internal Switch Setting 10.1
MAIN Board 10.1
DPU Board 10.1
Board Compatibility 10.2
MAIN Board 10.2
SpO_2 Board 10.2
ECG RESP1 Board, ECG RESP2 Board, ECG RESP3 Board and Motherboard 10.2

Internal Switch Setting

MAIN Board

When you replace the MAIN board with a new one, set the bit switches of DIP switch SW001 on the new MAIN board.

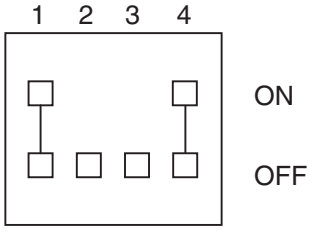


SW001

Bit 1:
ON: for BSM-5100 series
OFF: for BSM-4100 series
Bit 2: Reserved. Set to OFF.
Bit 3:
ON: for BSM-4100 series without recorder
OFF: for BSM-4100 series with recorder or BSM-5100 series
Bit 4: Reserved. Set to OFF.

DPU Board

When you replace the DPU board with a new one, set the bit switches of DIP switch SW801 on the new DPU board.



SW801

Bit 1: Check the switch setting according to the following table.

Board Model Number*	Board Serial Number* (Hardware Revision)	Bit 1 Switch Setting
UR-3563 (for BSM-4101/4103/4111/4113)	01733 (BB) or earlier	OFF
	01734 (BC) or later	ON
UR-35631 (for BSM-4102/4104/4112/4114)	00095 (AA) or earlier	OFF
	00096 (AB) or later	ON

* Model number and serial number of the board are shown on a label attached to the board.

Bits 2 to 3: Reserved. Set to OFF.
Bit 4:
ON: for MP506 Nellcor SpO_2 module
OFF: for MP304 Nellcor SpO_2 module

Board Compatibility

MAIN Board

Since the MAIN board has had a design change to be commonly used between the BSM-4100 series and BSM-5100 series, specify the appropriate hardware revision (indicated on the label on the board) when you issue an order for a replacement MAIN board.

If there is a MAIN board in your stock, check the hardware revision to determine if it is for BSM-4100 series only or for both BSM-5100 and BSM-4100 series.

Model	Hardware Revision BF or earlier	Hardware Revision BG or later
BSM-5100 series	Error	OK
BSM-4100 series	OK	OK

SpO_2 Board

Note that the SpO_2 function does not work if the software version 01-07 or earlier and hardware revision BC or later are used together.

	Hardware Revision BB or earlier	Hardware Revision BC or later
Software Version 01-07 or earlier	OK	Error
Software Version 01-10 or later	OK	OK

ECG RESP1 Board, ECG RESP2 Board, ECG RESP3 Board and Motherboard

When one of these boards has a failure, all of these boards must be replaced at the same time with the YS-086P0 (for BSM-4100J/K) or YS-086P1 (for BSM-4100A) ECG input block repair kit. This kit contains ECG RESP1 board, ECG RESP2 board, ECG RESP3 board and motherboard that are adjusted at the factory to work together.

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The model and serial number of your instrument are identified on the rear or bottom of the unit. Write the model and serial number in the spaces provided below. Whenever you call your distributor concerning this instrument, mention these two pieces of information for quick and accurate service.

Model _____ **Serial number** _____

Your Distributor

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